PHYSICAL SOCIETY EXHIBITION GUIDE

- ELECTRONICS
- TELEVISION
- RADIO • AUDIO

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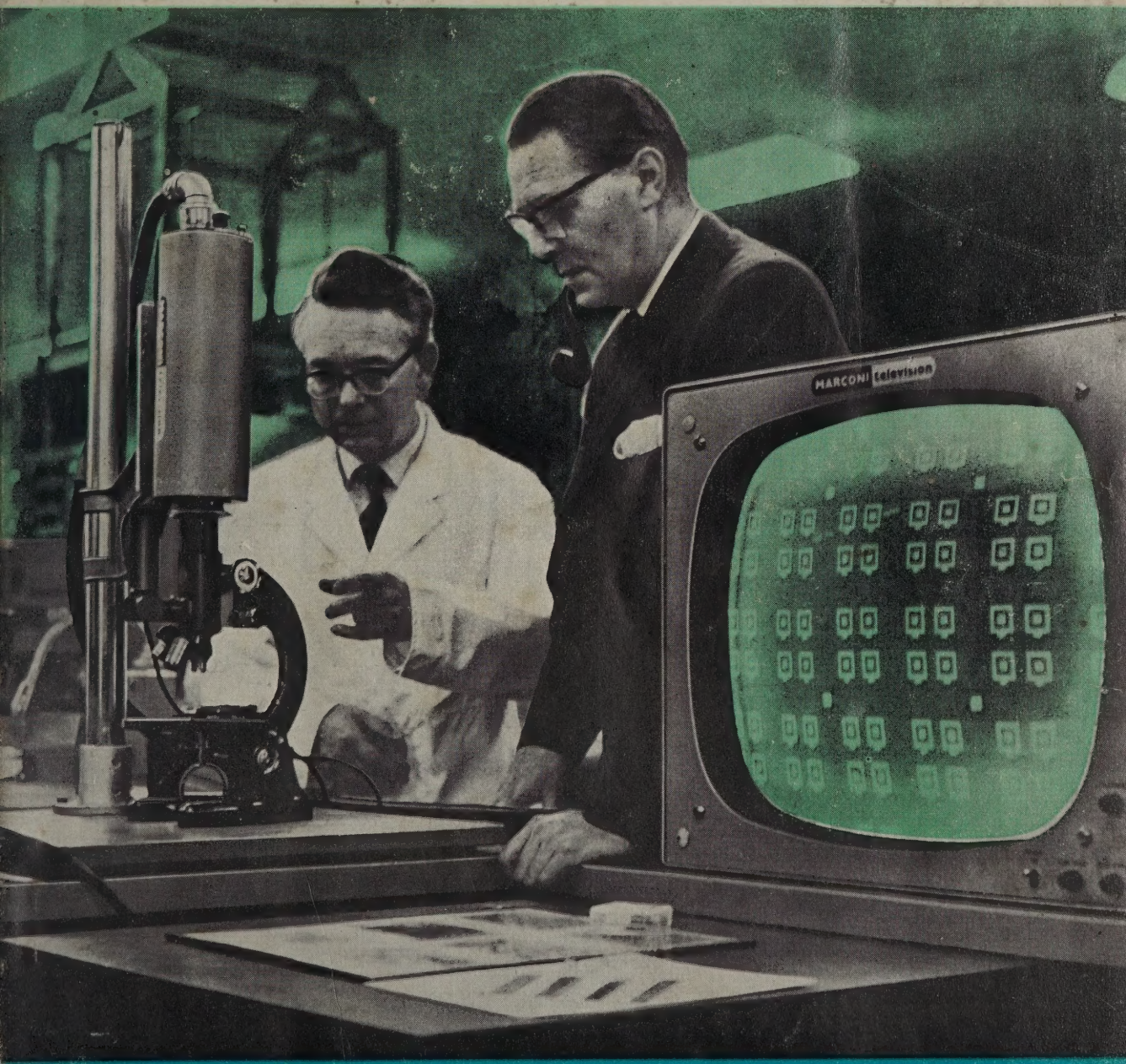

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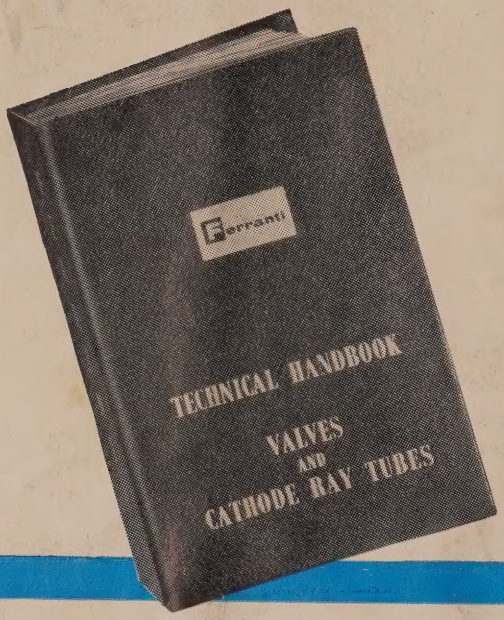

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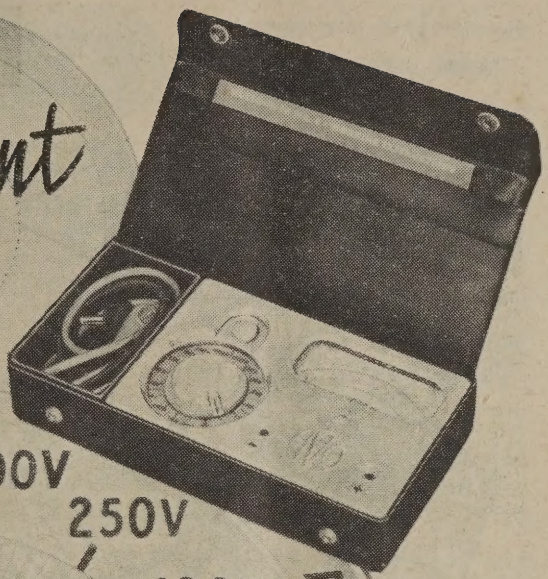
FE246/2

The little instrument with the BIG performance



MULTIMINOR Mk 4

The newly improved model of this famous AVO pocket size multi-range instrument has been enthusiastically acclaimed in all parts of the world for its high standards of accuracy and dependability as well as for its modern styling, its highly efficient internal assemblies and its resistance to extremes of climatic conditions.

It is simple to use, one rotary switch for instant range selection, only one pair of sockets for all measurements, and a 2¾-inch clearly marked scale-plate. It is supplied in an attractive black carrying case complete with interchangeable test prods and clips, and a multi-lingual instruction booklet.

Ask AVO to send you a full specification of this great little instrument. It measures only 7¾ x 4 x 1⅝ ins. and weighs only 24 ozs.

D.C. CURRENT: 100μA f.s.d.—1A f.s.d. in 5 ranges.
A.C. VOLTAGE: 10V. f.s.d.—1,000V f.s.d. in 5 ranges.
D.C. VOLTAGE: 2.5V. f.s.d.—1,000V f.s.d. in 6 ranges.
D.C. MILLIVOLT range: 0 —100mV f.s.d.
RESISTANCE: 0-2MΩ in 2 ranges, using 1.5V cell.
SENSITIVITY: 10,000Ω/V on d.c. voltage ranges.
1,000Ω/V on a.c. voltage ranges.

AVO LTD AVOCET HOUSE, 92-96 VAUXHALL BRIDGE ROAD, LONDON, S.W.1. *VICtoria 3404 (12 lines)* M GROUP

A8/7

4WW—008 FOR FURTHER DETAILS.

FM Radiotelephone Supreme

THE Viscount

unequalled for compactness performance & rugged reliability

- *25 or 50 kc channels*
- *Full 2 watts audio output 12 watts RF*
- *Up to 8 channels*
- *Robust splash and dustproof diecast case*
- *Modular unit construction 80% transistorised*
- *Printed circuits throughout*
- *Negligible battery drain— less than parking lights*
- *Selective calling facilities available as standard*
- *Fully tropicalised*

a demonstration cannot fail to convince you

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4WW—009 FOR FURTHER DETAILS.

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DAYSTROM

So easy to use

6 W STEREO AMPLIFIER KIT Model S-33

A versatile high-quality self-contained STEREO/MONAURAL Amplifier with adequate output for a living room. Can be used to convert a favourite (monaural) radiogram into a stereo-radiogram. 3 watts per channel; 0.3% distortion at 2.5 w/chnl.; 20 dB N.F.B., inputs for Radio (or Tape) and Gram, Stereo or Monaural; Ganged controls. Sensitivity 200 mV.

£13.7.6

6 W HI-FI STEREO AMPLIFIER KIT Model S-33H

An inexpensive stereo-mono amplifier with the high sensitivity necessary for lightweight miniature ceramic pick-ups (e.g., Decca Deram). De luxe version of the S-33 with attractive two-tone grey Perspex panel.

£15.17.6

5 W HI-FI MONO AMPLIFIER KIT Model MA-5

A low-priced general purpose Hi-Fidelity amplifier based on the popular S-33 and intended for those who do not require a stereophonic system. Separate bass and treble controls. Gram and Radio inputs. Suitable for most crystal pick-ups. A printed circuit simplifies construction.

£10.19.6

HI-FI SINGLE CHANNEL AMPLIFIER KIT Model MA-12

A compact high fidelity power amplifier (including auxiliary power supply). 12 watts output. Wide frequency range and low distortion. A variable sensitivity control is fitted enabling it to be used with an existing amplifier in a stereophonic system. Other applications include sound reinforcing systems, transmitter modulators, for use with tape recorders, also as a general purpose laboratory amplifier.

£11.18.0

STEREO-HEAD BOOSTER KIT Model USP-1

Hi-Fi Stereo Pre-amplifier for low-output Hi-Fi P.U.s Input 2 mV. to 20 mV. Output adjustable from 20 mV. to 2 V. 40-20,000 c/s. Also suitable as low-noise R.C.-coupled amplifier.

£7.7.6

STEREO CONTROL UNIT KIT Model USC-1

Incorporates all worthwhile features for high fidelity stereo and mono. Push-button selection, accurately matched ganged controls to ±1 dB. Negative feedback rumble and variable low-pass filters. Printed circuit boards. Accepts inputs from most tape-heads and any stereo or mono pick-up.

£19.10.0

Range of Assembled and Fully Finished
HI-FI EQUIPMENT CABINETS

By arrangement with RECORD HOUSING we can now supply you with any one of their large range of fully finished Equipment Cabinets.

May we send you details?

New!

PUBLIC ADDRESS AMPLIFIER KIT Model PA-1

This is a multi-purpose, high output, compact unit suitable for vocal and instrumental groups, guitars, electronic organs, etc. 4 inputs for guitars, mics., record players. Has many features found only in expensive equipment i.e., 50 watt R.M.S. (100 watts pk.) output, two heavy duty speakers. "Magic Eye" vol. indicator, variable tremolo, elegant cabinet. *Send for full details.*

£54.15.0

'MALVERN'

HI-FI EQUIPMENT CABINET KIT

AN ATTRACTIVE CABINET in modern style designed to house all your Hi-Fi equipment (including tape deck and full-sized transcription record player). The cabinet parts are veneered and pre-drilled, with edging in Panoplex plastic strip for ease of finishing. Complete with everything you need for assembly, including screws, hinges and even a padsaw! Left "in the white" for finishing to choice. Size 39⅛ x 32 x 21⅛in.

£18.1.0

TAPE AMPLIFIER KITS
Models TA-IM and TA-IS

This Combined Tape Record-Replay Amplifier is available in both monophonic and stereophonic models. Model TA-IM can be modified to the stereo version with modification kit TA-IC.

TA-IM £19/18/- TA-IS £25/10/- TA-IC £6/15/-

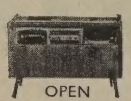
TELEPHONE AMPLIFIER KIT Model TTA-1 *For Home, Office or Shop*

Don't be tied to your telephone. By placing handset on Amplifier cradle you can talk or listen with both hands free. All transistor circuit, inductive pick-up coil, built-in speaker and volume control. 9 v. battery operated. Ivory toned cabinet. Size 6 x 5⅝ x 9¼in. deep.

£7.9.6

'GLOUCESTER'

HI-FI CABINET KIT



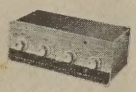
Will accommodate: Tape Deck and/or Record Player, F.M. Tuner and Stereo Amplifier. For those with limited floor space speaker systems can be housed at each end. For this purpose a loudspeaker kit comprising two 4in. plus 8in. speaker systems, balance unit, speaker grille, cutting template, padsaw and mounting details are also available. Neutral hardwoods have been carefully selected so that the finished product can be stained and polished to individual choice There is storage space for records, etc., also for power amplifiers. Dimensions: length 46½in., height 30in., depth 21in.

Mk. I for Tape Deck or Record Player... **£17 3 6**

Mk. II for both T/D and R/P..... **£18 10 0**

TAPE DECKS Are available as "packaged deals" with other equipment. Details on request.

MONO CONTROL UNIT KIT Model UMC-1



Ideal for use with MA-12 or similar amplifier. Output 0.25 v. *Send for full details.*

£8.12.6

HI-FI STEREO AMPLIFIER KIT Model S-99

Gives 18 w. output (9 per channel with 0.2 per cent. distortion at 9 w. per channel). It has ganged controls. STEREO/MONAURAL gram., radio and tape recorder inputs and push-button selection as well as many other first-class features well above its price range. In grey metal cabinet with a golden surround and Perspex panel. Also ultra-linear push-pull output. Printed circuit construction.

£27.19.6

HI-FI SPEAKER SYSTEM KIT Model SSU-1

Ducted port bass reflex cabinet, "in the white." Frequency response is 40–16,000 c/s. Power rating 25 watts. Matched speaker units 8in. high flux (12,000 lines) with hyperbolic cone and 4in. wide angle dispersion type for higher frequencies. With legs £11/12/-.

£10.17.6

"COTSWOLD" SPEAKER SYSTEM KIT

This acoustically designed enclosure measures 26 x 23 x 14½in., and houses a special 12in. bass speaker with 2in. speech coil, elliptical middle speaker together with a pressure unit to cover the full frequency range of 30–20,000 c/s. Its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete, with speakers, cross-over unit, level control, Tygan grille cloth, etc. Left "in the white" for finish to personal taste, all parts are precut and drilled for ease of assembly.

£23.4.0

"COTSWOLD M.F.S." SPEAKER SYSTEM KIT

This model, based on the standard Cotswold, measures only 36in. high, 16½in. wide by 14in. deep. Particularly recommended to those who require the best results in small rooms.

£23.4.0

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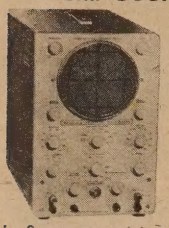
5in. OSCILLOSCOPE KIT Model O-12U



Laboratory quality at utility oscilloscope price and ease of assembly make this kit of outstanding value. Vertical frequency response 3 c/s to 5 Mc/s., +1.5 dB. −5 dB., sensitivity 10 mV. per cm. at 1 kc. Horizontal frequency 1 c/s. to over 400 kc/s (±1dB. up to 200 kc/s.) The Heath patented sweep circuit functions from 10 c/s. to 500 kc/s., in five ranges giving five times the usual sweep of other 'scopes. In addition it has exceedingly short re-trace and rise times and electronically stabilised power supply. Included is a 48-page Instructional Manual. **£35.10.0**

ELECTRONIC SWITCH KIT Model (Oscilloscope Trace Doubler) S-3U

This extremely useful, low priced device will extend the use of your single-beam oscilloscope for duties otherwise only in the province of the double-beam tube. In short, at a nominal cost, the Heathkit model S-3U will give you the advantages of a double (or other multiple) beam 'scope, while retaining all the advantages of your present single-beam instrument.
Hitherto an electronic switch of this nature, permitting the simultaneous observation of two signals on the screen of a single-beam C.R.T. oscilloscope, has cost nearly as much as the 'scope itself. **£12.18.0**

RESISTANCE-CAPACITANCE BRIDGE KIT Model C-3U

Measures capacitance 10pF to 1,000μF, resistance 100Ω to 5 megohms and power factor, 5-450 V. test voltages. Safety switch provided. **£10.10.0**

MULTIMETER KIT Model MM-1U

Provides wide voltage current, resistance and dB ranges to cover hundreds of applications. Sensitivity 20,000 ohms/volt D.C. and 5,000 ohms/volt A.C. Ranges: 0-1.5 v. to 1,500 v. A.C. and D.C.; 150μA to 15A D.C.; 0.2Ω to 20MΩ. 4½in. 50μA. meter. **£12.18.0**

AUDIO SIGNAL GENERATOR KIT Model AG-9U

10 c/s to 100 kc/s., switch selected. Distortion less than 0.1%. 10 v. sine wave output metered in volts and dB's. **£22.10.0**

AUDIO VALVE MILLIVOLTMETER KIT Model AV-3U

Very sensitive. High stability. 1 mV. to 300 V. A.C. 10 c/s. to 400 kc/s. **£16.10.0**

AUDIO WATTMETER KIT Model AW-1U

This popular meter is used in many recording studios and broadcasting stations as a monitor as well as for servicing purposes. Dissipation rating up to 25 w. continuous. 50 w. intermittent. **£17.5.0**

New! 'OXFORD' Dual-wave LUXURY TRANSISTOR PORTABLE RADIO KIT Model UXR-2

Ideal for use as a domestic, car or personal receiver. Please send for full details. **£14.18.0**

HI-FI F.M. TUNER KIT

Tuning range 88-108 Mc/s. Flywheel tuning. Attractive Plastic Front Panel in two-tone grey with golden trim surround and motif. Thermometer type visual tuning indicator. Pre-aligned I.F. transformers. Three I.F. stages. Wide-band low distortion Ratio Detector. R.F. Unit, wired, tested and pre-aligned. Printed circuit for I.F. Amplifiers and Ratio Detector. Built-in power supply. Output sockets for stereophonic adaptor (for stereo transmission when available).

TUNER UNIT Model FMT-4U with 10.7 Mc/s. I.F. output **£2.15.0** (inc. P.T.)
I.F. AMPLIFIER and Power Supply Mode! FMA-4U complete with case and valves. **£13.3.0.** Sold separately.
Total **£15.18.0**

A.M./F.M. TUNER KIT

Tuning range 88-108 Mc/s. (FM) 16-50, 200-550, 900-2,000 m. Flywheel tuning. Attractive Perspex front panel in two-tone grey with golden trim. Thermometer type tuning indicator, pre-aligned I.F. transformers. Switched wide and narrow AM bandwidths.

TUNING HEART Model AFM-T1 £4.13.6 (inc. P.T.). **I.F. AMPLIFIER and Power Unit Model AFM-A1.** Complete with metal cabinet and valves **£21.16.6.** Sold separately. Total **£26.10.0**

TRANSISTOR PORTABLE RADIO KIT Model UXR-1

Presented in elegant real hide case with tasteful gold relief. Can be assembled in 4 to 6 hours and you have a set in the top flight of transistor portables. Pre-aligned I.F. transformers, printed circuit and a 7in. x 4in. high-flux speaker. **£12.11.0**

4-wave TRANSISTORISED PORTABLE RADIO KIT Model RSW-1

Using 7 latest type transistors and three diodes this highly sensitive set is specially designed for Short and Medium wavebands (200-550, 90-200, 20-40 and 11-16 m.). In solid leather case fitted with retractable whip aerial. **£19.17.6**

VALVE VOLTMETER KIT Model V-7A

The world's most popular valve voltmeter, with printed circuit and 1 per cent. precision resistors to ensure consistent laboratory performance. It has 7 voltage ranges measuring respectively d.c. volts to 1,500 and A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance measurements from 0.1 ohm to 1,000 Megohms with internal battery. D.C. input impedance is 11 megohms and dB measurement has a centre-zero scale. Complete with test prod, leads and standardising battery. **£13.18.6**

HIGH VOLTAGE PROBE KIT Model HV-336

Extends measurement up to 30,000 v. D.C. with negligible circuit loading. A special High Stability 1,090 megohm resistor gives a multiplication factor of 100X when used with a valve voltmeter of 11 megohms input impedance such as the V-7A **£2.19.6**

R.F. PROBE KIT Model 309-CU

This complete probe kit will extend the frequency range of the V-7A Valve Voltmeter to 100 Mc/s. and will enable useful voltage indication to be obtained up to 300 Mc/s. **£1.13.6**

POWER SUPPLY UNIT KIT Model MGP-1

Compact, general purpose unit suitable for F.M. Tuners, Tape Recording Amplifiers and general laboratory use. Input 100/120 v., 200/250 v., 40-60 c/s. Output 6.3 v. 2.5 A. A.C.; 200, 250, 270 v. 120 mA. max. D.C. **£5.2.6**

DECADE CAPACITOR KIT Model DC-1

Capacity values 100μμF to 0.111μF in 100μμF steps. Precision silver-mica capacitors and minimum loss ceramic wafer switches ensure high accuracy. **£7.5.0**

DECADE RESISTANCE BOX KIT

Model DR-1U. Range 1-99,999Ω in 1Ω steps. Ceramic switches throughout. Current rating from 500 mA. to 5 mA. according to decades in circuit. Polished wooden cabinet supplied complete **£10 8 0**

R.F. SIGNAL GENERATOR KIT Model RF-1U

Provides extended frequency coverage on six bands from 100 kc/s. 100 Mc/s. on fundamentals and up to 200 Mc/s. on calibrated harmonics. **£13.8.0**

2¾in. SERVICE OSCILLOSCOPE KIT Model OS-1

Light, compact, portable for service engineers. Printed circuit board for easy construction. Wt. 10½ lb. Size 5in. x 8in. x 14½in long. **£21.18.0**

CAPACITANCE METER KIT Model CM-1U

This Direct-Reading Capacitance Meter is a very low priced, time-saving instrument which is so useful that it should be part of the general equipment of every electronic laboratory and production line. Easily built in a few hours. 0-100μμF, 0-1,000μμF, 0-0.01μF, 0-0.1μF. The meter has 4½in. scale and can be used by an unskilled operator after a few minutes' instruction. **£15.15.0**

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AMATEUR TRANSMITTER KIT
Model DX-40U

Covers all amateur bands from 80 to 10 metres, crystal controlled. Power input 75 watts C.W. 60 watts peak controlled carrier phone. Output 40 watts to aerial. Provision for V.F.O. Filters minimise T.V. interference. **£33.19.0**

SINGLE SIDEBAND ADAPTER KIT
Model SB-10U

May be used with most A.M. transmitters with certain provisions. Allows full use of existing equipment for SSB facilities. Band coverage: 80, 40, 20, 15, 10 m. Unwanted sideband suppression; Better than 30 dB. Carrier suppression; Better than 40 dB. Power requirements: 300 v. D.C. 85 mA. (average), 30 mA. (standby), 140 mA. (transmit). 6.3 v. A.C., 3.5 A. Meter: 2½in. Scale edge reading, 200μA movement, indicates carrier null and relative power output. Cabinet 11in. high x 8in. wide x 14¾in. deep. **£39.5.0**

AUDIO SINE-SQUARE WAVE GENERATOR KIT. Model AO-1U

An inexpensive generator which covers 20 c/s to 150 kc/s in four ranges with choice of sine or square waves. The latter up to 50 kc/s. Output voltage 10 v. max. and distortion less than 1%. An ideal instrument for audio testing. Size 9½in. x 6½in. x 5in. **£14.15.0**

GRID-DIP METER KIT Model GD-1U

Functions as oscillator or absorption wave meter. With plug-in coils for continuous frequency coverage from 1.8 Mc/s to 250 Mc/s. **£10.19.6**

Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. With dial correlation curves, **17/6.**

TRANSISTOR INTERCOM. KITS
Models XI-1U and XIR-1U

Ideal for home or business use. Up to five remote stations can be operated with each Master. The Master unit can call any one, any combination, or all five Remote stations and any Remote station can call the Master. A private call to any Remote station cannot be interrupted or overheard by any other while a conversation is in progress. Any Remote station can talk to any one or all others provided the Master is manned. These kits have been designed for easy construction and high performance.
The mahogany veneered wooden cabinets are supplied completely assembled and finished. The Master unit has a 4-transistor amplifier and is operated by an internal 9 v. battery as are the Remote units. Batteries are not included with the Kits.
Model XI-1U (Master) **£10.19.6**

Model XIR-1U (Remote) **£4.7.6**

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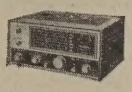
ELECTRONIC WORKSHOP KIT Mod. EW-1
Makes over 20 experiments **£7.13.6**

TRANSISTOR RADIO KIT Mod. UJR-1
An ideal introduction to radio **£2.7.6**

Additional Amplifier Stage UJR-1S 16/6 extra.

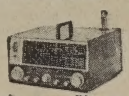
AMATEUR BANDS RECEIVER KIT Model RA-1



This receiver is designed as an ideal economically priced fixed station, portable or mobile receiver covering the amateur bands from 160-10 m., each band separately calibrated on a large illuminated slide-rule dial. Approx. 5in. bandspread on each band.
Features: Signal strength (tuning) 'S' meter, front panel dial calibration control, provision for a 100 kc/s calibrator, tuned R.F. amplifier stage, half-lattice filter, adjustable noise limiter. Excellent electrical and mechanical stability.
Frequency coverage: 160, 80, 40, 20, 15, 10 metre bands. I.F. 1620 kc/s. Sensitivity: 2 μV for 10 dB S/N, image rej. 40 dB. Power requirements: 110-240 V. A.C. 40-60 c/s. (Provision for external P.S. for mobile use). Size 13¾in. wide x 6¼in. high x 10¾in. deep.

Write for specification leaflet. **£39.6.6**

"MOHICAN" GENERAL COVERAGE RECEIVER KIT
Model GC-1U



This fully transistorised receiver includes 4 piezo-electric transfilters. Ideal for fixed or portable use. The R.F. "front end" is supplied as a pre-aligned, pre-assembled unit. Features include: 10 transistor circuit, printed circuit board, telescopic whip aerial, tuning meter, large slide-rule dial. Frequency coverage: 580 kc/s to 30 Mc/s in 5 switched bands. Electrical band spread on the Amateur bands 80-10 m. Size 6¾in. x 12in. x 10in. Powered by two 6 v. dry batteries (not supplied). Please write for full specification. **£39.17.6**

STABILISED POWER PACK
Models MSP-1M and MSP-1W

Specially recommended for industrial and laboratory use, meeting the need for a reliable and versatile stabilised power pack capable of a very high performance. Input 200-250 v., 40-60 c/s., A.C., fully fused. Outputs: H.T. 200-410 v. D.C. at 20-225 mA. in 3 switched ranges. Unstabilised A.C. 6.3 v. at 4.5 A. centre-tapped. Two 3in. "easy-to-read" meters for reading voltage and current simultaneously. Separate L.T. and H.T. supply transformers. All output circuits are isolated. Size 13in. x 8½in. x 9½in.
MSP-1M (with meters) **£36.12.6**

MSP-1W (without meters) **£29.17.6**

BALUN COIL UNIT KIT

Model B-1U. Will match unbalanced co-axial lines to balanced lines of either 75 or 300Ω impedance. Frequency range 10-80 m., input up to 200 watts. **£4.15.6**

All prices include free delivery in U.K.

● **Deferred Terms** ●
available on all orders above £10.

NEW! GENERAL COVERAGE COMMUNICATIONS RECEIVER KIT
Model RG-1

Of similar size and appearance to the model RA-1. Frequency coverage from 600 kc/s. to 1.5 Mc/s and 1.7 Mc/s to 32 Mc/s in 6 switched bands. Its many features include Half-lattice crystal filter.
Send for full details. **£39.16.0**

AMATEUR TRANSMITTER KIT
Model DX-100U
The World's most popular Amateur TX Kit

- Completely self-contained compact Amateur Transmitter, 150 w. D.C. input.
- Built-in highly stable VFO and all Power Supplies.
- TVI: Careful design has reduced TVI to a minimum by use of effectively screened frequency-generating stages and pi-tuned circuits at the input and output of the PA stage and by 11 chokes and pi network filters to all outlets from the cabinet. No fewer than 35 disc-ceramic by-pass capacitors help to achieve the exceptional stability and high-performance for which this Transmitter is noted.
- The KT88 high-level anode and screen modulator stage gives over 100 watts of audio from less than 1.5 mV. input.
- Adjustable drive and clamp control ensure that valves are only driven sufficiently to maintain the required output.
- Keying on CW is via the VFO and buffer amplifier cathodes; the other RF valves are biased beyond cut-off. When zero-beating the TX with incoming signals, the exciter stages only may be run without the final amplifier being switched on.
- Provision has been made for remote control operation.
- VFO slow-motion drive is very smooth and backlash free. ● VFO or Crystal control.
- Covers all Amateur bands up to 30 Mc/s 'phone or CW. **£79.10.0**

VARIABLE FREQUENCY OSCILLATOR KIT. Model VF-1U

Specially designed to meet the demand for the maximum possible flexibility from an amateur Transmitter which would otherwise be subject to certain limitations imposed by crystal control. Calibrated for all Amateur bands 160-10 meters, fundamentals on 160 and 40 m. Ideal for Heathkit DX-40U and similar transmitters. **£12.10.0**

Q MULTIPLIER KIT. Model QPM-1

A reasonably priced Q Amplifier for the amateur and short-wave enthusiast. This self-powered unit (200-250 v. 50/60 c/s.) may be used with communications receivers to provide both additional selectivity and signal rejection
Model QPM-1 for 470 kc/s IF. Either Model QPM-1G for 1.6 Mc/s IF Model **£8.10.0**

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Full details of Model(s).....

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ADDRESS .....

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DAYSTROM LTD.

DEPT. W.W.1, GLOUCESTER, ENGLAND

THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

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C.R.B. AUTOMATIC FREQUENCY RESPONSE TRACER

A UNIQUE AID TO DEVELOPMENT AND PRODUCTION TESTING

CRB

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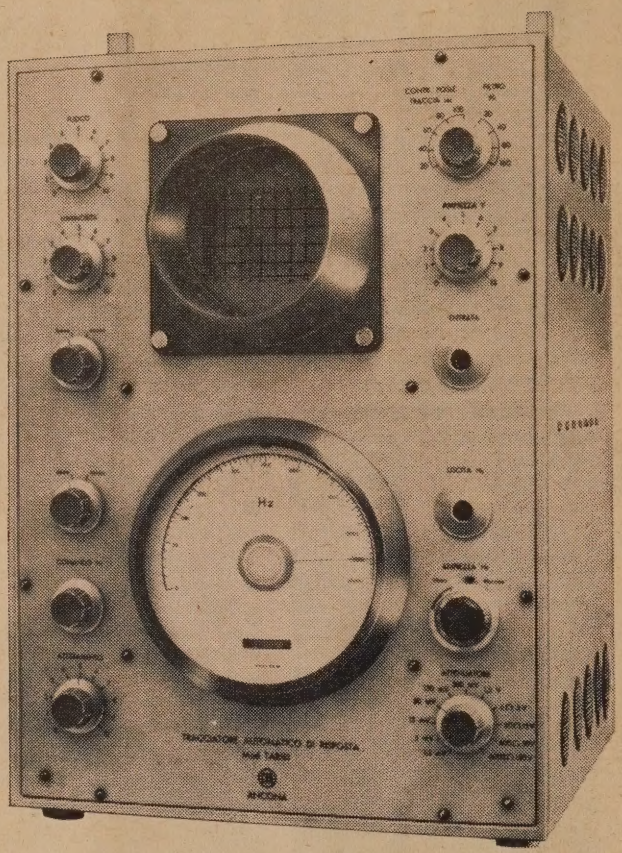

C.R.B. Type TAR/61 Automatic Frequency Response Tracer

The TAR/61 is an audio frequency spectrum analyser which directly displays on a CRT screen an amplitude/frequency response curve. It is self-contained, including a low-distortion automatically swept power oscillator providing the input to the device under examination. Unequalled simplicity in use and directness of presentation make it essential to all engaged in production or test of amplifiers, filters, recorders, loudspeakers, microphones, pickups and transducers. *As the exclusive U.K. representatives, Claude Lyons Ltd will be glad to supply full technical information on this invaluable instrument.*

- Range — 20 c/s to 20 kc/s
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- Distortion below 1·5% at 1 watt
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76 Old Hall Street, Liverpool 3. MARitime 1761

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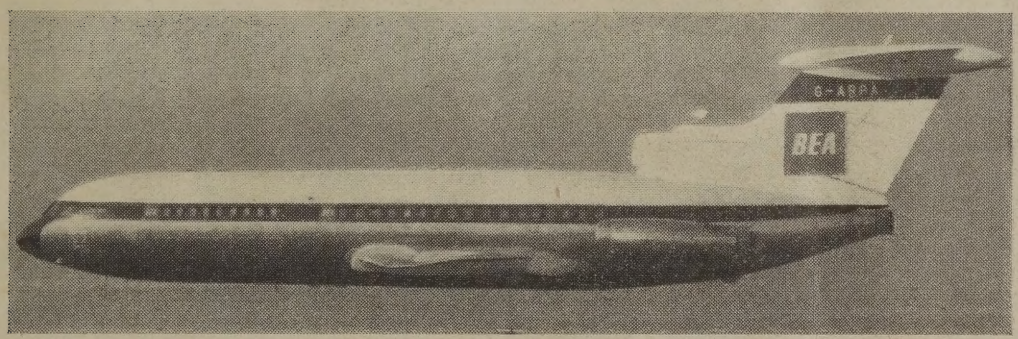

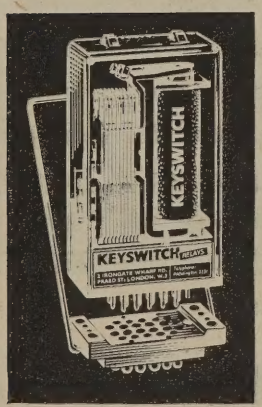

equipped with 'KEYSWITCH' P33 Plug-in 3000 Type Relays for flight test trials

made to withstand the most arduous conditions

Manufactured and supplied by

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Tel.: GLAdstone 1152 (5 lines)

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Four simultaneous speech channels, or any combination of speech, teleprinter, facsimile or tone intelligence signals.

Four crystal controlled spot frequencies, 2 to 16 Mc/s.

100 watts p.e.p output, continuous rating (or 750 watts with the G.A.406 amplifier).

Compatible with Standard International ISB systems.

Completely transistorised receiving terminal and transmitter drive unit.

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Rx2

NIGHT AND DAY—MILITARY COMMUNICATIONS WITH THE HF156

The HF156 manpack transmitter/receiver is a tough, reliable portable set for active service in all climates. It's robust, fully sealed and entirely self-contained. Six crystal-controlled channels, extreme simplicity of operation and exceptional range on voice and CW are some of the many features that stand out in active service with the British Army.

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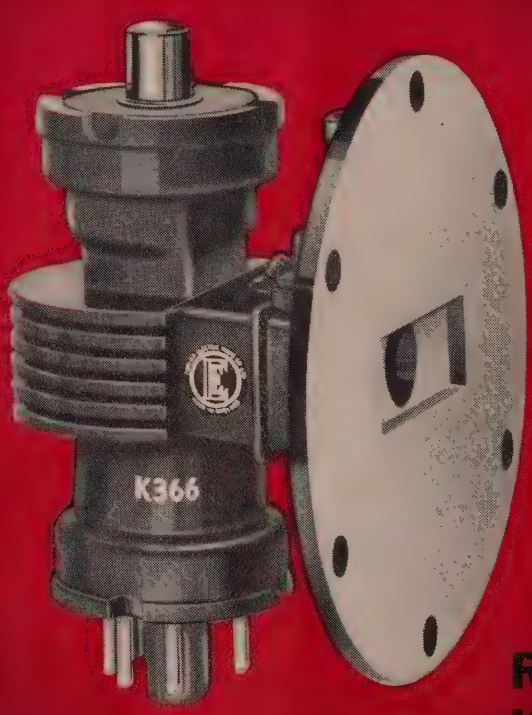

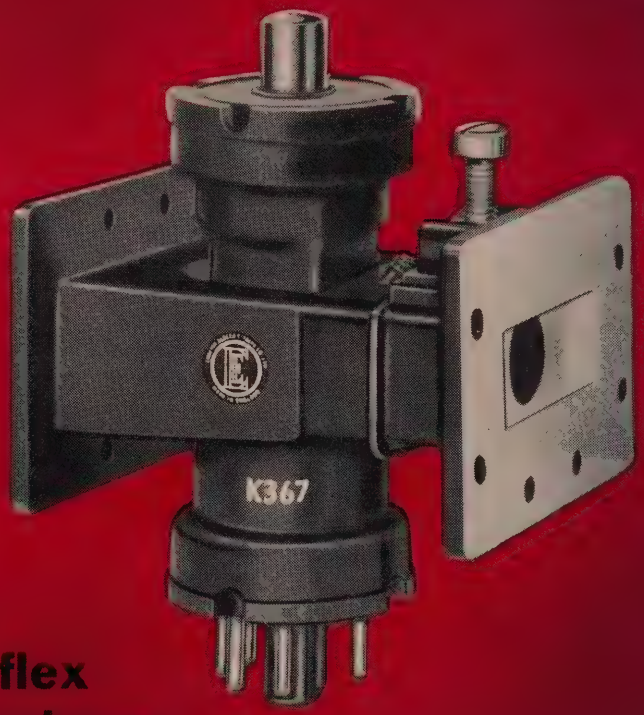

Reflex Klystrons for Microwave Relays

K366 AND 367 SERIES — 1·2 WATTS AT FREQUENCIES 6125 TO 7750 Mc/s

The K366 and K367 series of reflex klystrons manufactured by **English Electric Valve Co. Ltd** are designed specifically for reliable transmitter service in microwave relays. The valves in both series are electrically identical and have a typical output power of 1·2 watts. They cover the frequency range 6125 to 7750 Mc/s in steps of approximately 300 Mc/s and are tuned mechanically in the external cavity. Good frequency stability and good linearity of frequency versus reflector voltage characteristic ensure low F.M. distortion. The K366 types (equivalent to the American VA220 series) are forced air cooled and those of the K367 series (equivalent to American VA222 series) are conduction cooled. For full information on both the K366 and K367 series please write to the Company.

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ENGLISH ELECTRIC VALVE COMPANY LIMITED

AGENTS THROUGHOUT THE WORLD | *Chelmsford, England. Telephone: Chelmsford 3491*

this stabiliser is news!

Claude Lyons new BTR solid-state voltage stabiliser

high accuracy | low distortion | high reliability | high-speed response | low price

The new type BTR represents a major advance in **a.c.** voltage stabiliser design.

The proven transductor regulating circuit is employed in an entirely new configuration (patent pending) giving remarkably low harmonic distortion *without filtering*, together with the high output stability of ±0.3%. The output is unaffected by frequency variations from 45 to 65 c/s and load variations from zero to full load.

The design features solid-state circuitry and a printed circuit plug-in control amplifier which, together with the absence of valves, relays or moving parts, provide extremely high reliability.

Three models are available, rated at 2, 5 and 13 amperes. The operating voltage can be set at any value from 200 to 254 volts, and three alternative input ranges are provided.

In addition, for particularly critical applications, filtered models are available, in which, at the filter frequency, the distortion is reduced to a truly negligible level, and the stability further improved to ±0.2%.

The BTR range offers high accuracy, rapid response, very low distortion, rugged reliability and—due to the simple and efficient design—at prices unusually low for this class of instrument.

BASIC MODELS				
Type	Rating	Accuracy	Distortion	Price £ s.
BTR-2	480 VA	±0·3%	<6%	49 10
BTR-5	1200 VA	±0·3%	<6%	67 10
BTR-13	3100 VA	±0·3%	<7%	105 0
FILTERED MODELS				
BTR-2F	480 VA	±0·2%	<2%	58 10
BTR-5F	1200 VA	±0·2%	<2%	83 10
BTR-13F	3100 VA	±0·2%	<2·5%	133 0

115 volt models are also available

Our complete range of stabilisers includes models with ratings up to 120kVA single phase, 360kVA three phase. Write for full information to Publicity Department, Hoddesdon.

Claude Lyons

CLAUDE LYONS LTD

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76 Old Hall Street, Liverpool, 3. *MARitime 1761. Telex 62181*

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TELCON HIGH PERMEABILITY TOROIDAL CORES

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Telcon Pioneered the Production of Strip Wound Cores which are available in

MUMETAL, SUPERMUMETAL
RADIOMETAL, SUPER RADIOMETAL
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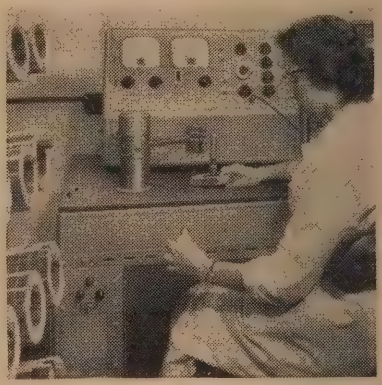
All these alloys are manufactured EXCLUSIVELY by Telcon Metals Limited at Crawley, Sussex, where melting, hot and cold rolling, slitting and core fabrication are carried out under close technical supervision. Inspection starts with the raw materials, is maintained throughout the production processes and ends with an individual magnetic test on every finished core.

Typical Spiral Cores

WHEN YOU BUY TELCON CORES YOU BUY RELIABILITY

Cores are available in a wide variety of sizes and strip thicknesses down to 0.000125″ (3 microns) and full technical information will gladly be sent on request. Core finishes can be made to suit customer requirements which include epoxy resin and other coatings, metal casings and sealed boxes of various plastic combinations.



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FOR SPIRAL CORES – WHATEVER THE APPLICATION

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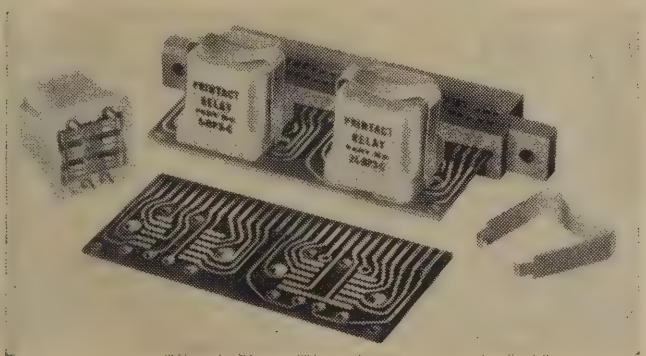
Complete in a 7/8 in. cube

Weighs only 0·8 oz.

'Printact' Plug-in Printed Circuit Relay



- NO SPRINGS
- NO WIRING
- NO SOLDERING
- NO MECHANICAL LINKAGES
- NO EXPOSED PARTS

The highly reliable Printact Relay, which mounts on and becomes an integral part of your printed circuit board, makes possible substantial savings in space, weight and assembly costs. Mechanical linkage and fixed contacts on the relay are eliminated entirely. The moving contacts which are part of the armature assembly, mate with rhodium over nickel-plated copper conductors printed on your circuit board. Spring connectors on the coil leads eliminate soldering.

Fully encapsulated in a ⅞in. high-impact plastic cube, the Printact relay employs a permanent magnet in place of a return spring to hold the armature open. The magnetic force remains constant eliminating the need for maintenance adjustment. Recommended configurations for your circuit layout, provide for switching up to three form A and B or form C, or up to five pole to a common line.

Coil resistance of the standard 6, 12 and 24 volt D.C. relays are 75,300 and 1,200 ohms (500 milliwatts) with pull-in occuring at 80% of rated voltage. Variations of coil resistance are available on special order.

Operating life exceeds 5,000,000 operations when contact load is from dry circuit up to ¼ amp 24 volts D.C.

Contact Material	Gold alloy or Palladium
Power Consumption	500 mw (at rated voltage)
Operating Temperature	−30°C to +95°C.
Operate Time	3 to 7 ms. at rated voltage
Dimensions and Weight	⅞ × ⅞ × 1 3/16—0.8 oz.
Dielectric Test	1000 volts RMS 60 cps.

Other Printact features include Bifurcated contacts: Double-break contacts; Balanced armature; Enclosed housing; Plug-in application; Encapsulated coil; Self-wiping contacts; Inherent snap action, greater switching versatility.

ALSO A LATCHING RELAY USING CERAMIC MAGNET

Cost of inexpensive latching Relay is less than half that of competitive relays because of "Printact" permanent ceramic magnet latching principle and balanced armature which eliminates all mechanical linkage. Reliability has been shown by mechanical life tests exceeding 10^8 cy and electrical tests exceeding 5×10^6 cy.

Available with single or double coil, relay features bifurcated contacts of gold alloy or palladium. D-c pulse of 7 ms duration at rated voltage will switch snap action relay. Single coil unit is rated 500 mw. and switches d-c polarity to switch modes. Two-coil unit is rated 1-w and uses one coil for switching in and other for switching out.

Sole distributors for 'Printact' Relays:

A.D.S. RELAYS LTD.

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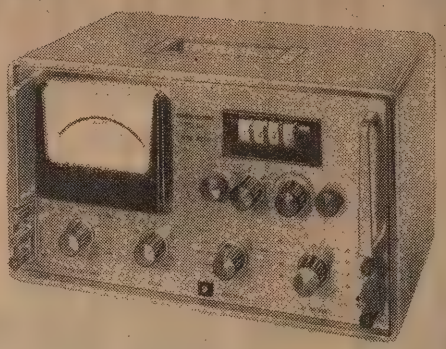
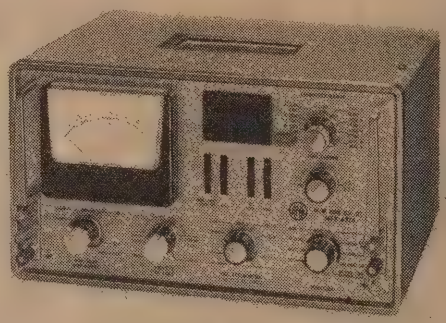
SOLID-STATE MULTI-FACILITY TEST SETS

for specific test facilities

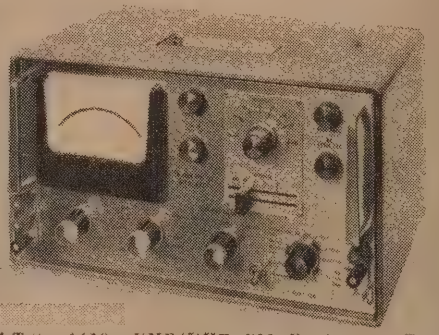
AWA is proud to announce the first three instruments in their new range of transistorised, modular test equipment. This range is based on a concept in which known testing requirements are met by a series of plug-in module units, each module providing a test facility. Various combinations of these modules will therefore provide those test facilities explicitly required for a particular system or equipment.
Each group of modules is housed in a standard case and front panel layouts have been chosen to provide a maximum of operator convenience and to maintain, where possible, uniform appearance. The Test sets may be powered by batteries or mains supplies, the power units being completely interchangeable.



M.T.S. A210—Audio/Ultrasonic Test Set for the complete evaluation of audio and ultrasonic amplifiers, filters and transmission circuits.



M.T.S. A310—MF/HF Radio Equipment Test Set for checking medium-frequency and high-frequency radio communication equipment, particularly marine installations.



M.T.S. A410—VHF/UHF FM Equipment Test Set for field and workshop checking of f-m receiving and transmitting equipment.

AWA AUSTRALIA'S NATIONAL WIRELESS ORGANISATION

Enquiries
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47 York St., Sydney; Melbourne; Brisbane; Wellington N.Z.; London.
U.K. Representatives
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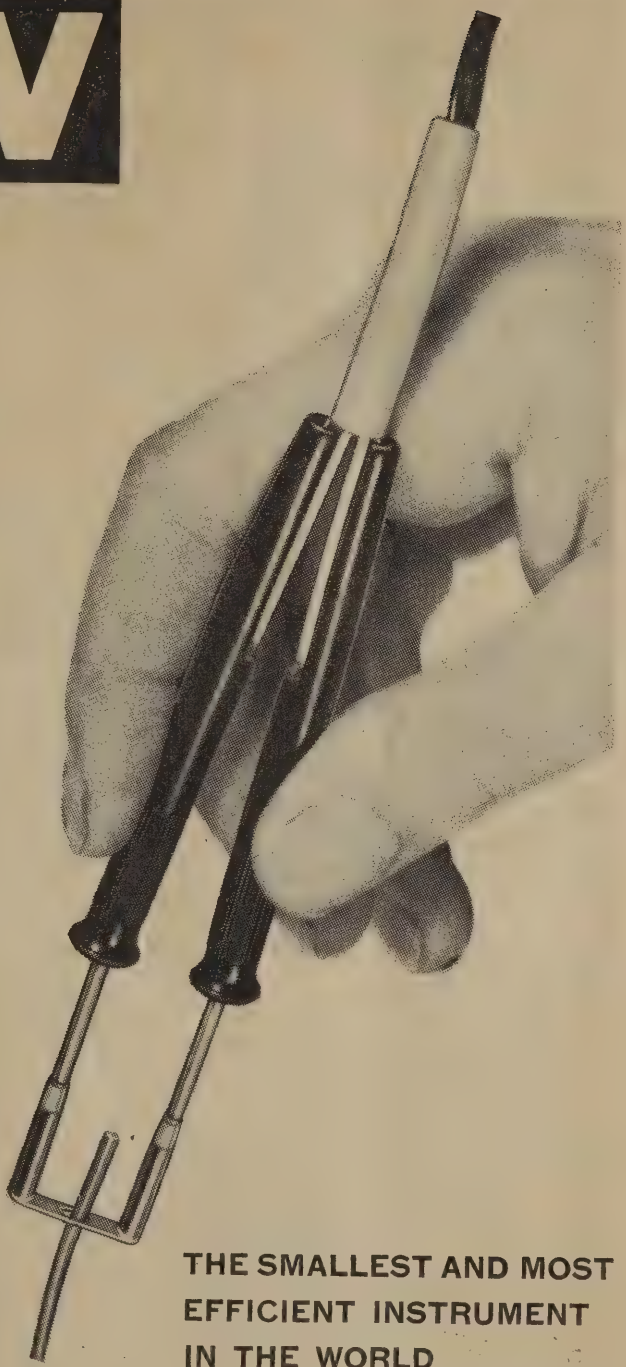
NEW

ORYX

MINIATURE HEAT WIRE STRIPPERS



This new low voltage Duo-Thermal Wire Stripper has been designed to fill the need for speedy and efficient stripping of wire insulation such as PVC, Nylon, Rubber and Thermoplastics.

Two models are available:—

Micro-Miniature Stripper ST-6—accommodates wires of up to $\frac{1}{8}$in. (3 mm.) diameter, and operates at 250°C.

Miniature Stripper ST-18—accommodates wires of up to $\frac{1}{4}$in. (6 mm.) diameter and operates at 325°C.

Both models house a miniature heating element in each limb, total consumption for Model ST-6 being 12 watts and for Model ST-18 being 25 watts.

They are both available for 6 or 12 volt operation.

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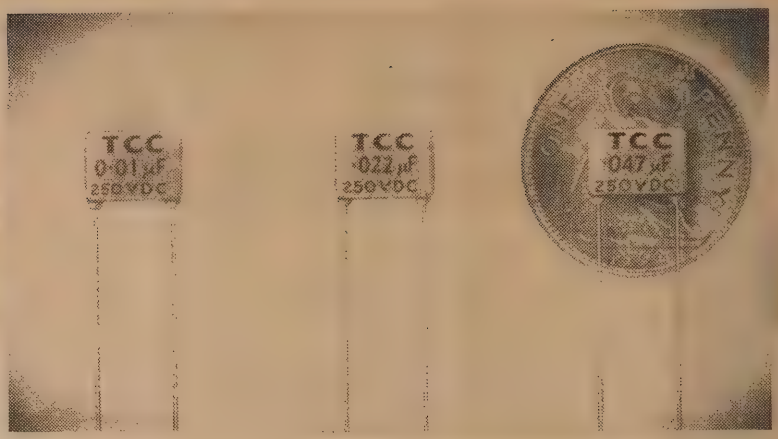
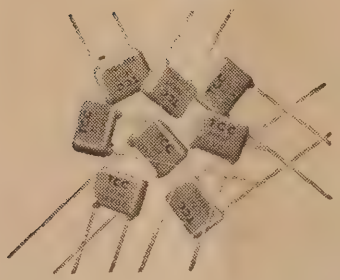




MINIATURE METALLIZED POLYESTER CAPACITORS

These small moulded metallized polyester capacitors are ideally suited to the applications to printed wiring panels and transistorised circuits. The use of the new dielectric material and unique construction combine the advantages of small physical size and superior electrical characteristics which meet the requirements of H.5 DEF.5011 Specification.

CONSTRUCTION

The windings are virtually non-inductive and the wire terminations are soldered direct to the metal electrodes eliminating contact resistance and ensuring the minimum possible inductance.

Cap. Tolerance: ±20%.

Rating—Working: PMX 1-4 250 V. D.C. PMX 6-7 400 V. D.C. at +85°C.

Test: PMX 1-4 400 V. D.C. PMX 6-7 600 V. D.C. for 2 secs. at +20°C.

Power Factor: ≤0.01 at 1,000 cps at +20°C.

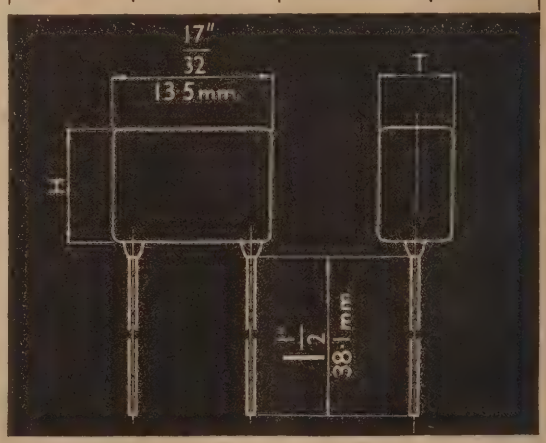
Temperature Rating: Suitable for working at +85°C. without derating.

Insulation Resistance: 25,000 megohms at +20°C.

Terminations: 22 SWG solder coated parallel wires for slide mounting.

Finish: Insulated—special non-cracking heat resisting thermosetting compound providing good insulation and good protection against the ingress of moisture.

Capacitance μF	Dimensions H	Dimensions T	T.C.C. Type No.
250 V. D.C. RANGE			
0.01	11/32in. 9mm	7/32in. 5.5mm	PMX1
0.015	11/32in. 9mm	7/32in. 5.5mm	PMX1A
0.022	11/32in. 9mm	7/32in. 5.5mm	PMX2
0.033	11/32in. 9mm	7/32in. 5.5mm	PMX2A
0.047	11/32in. 9mm	7/32in. 5.5mm	PMX3
0.068	7/16in. 11mm	9/32in. 7.2mm	PMX4A
0.1	7/16in. 11mm	9/32in. 7.2mm	PMX4
400 V. D.C. RANGE			
0.01	11/32in. 9mm	7/32in. 5.5mm	PMX6
0.022	11/32in. 9mm	7/32in. 5.5mm	PMX6A
0.033	13/32in. 10mm	17/64in. 7.0mm	PMX7A
0.047	13/32in. 10mm	17/64in. 7.0mm	PMX7



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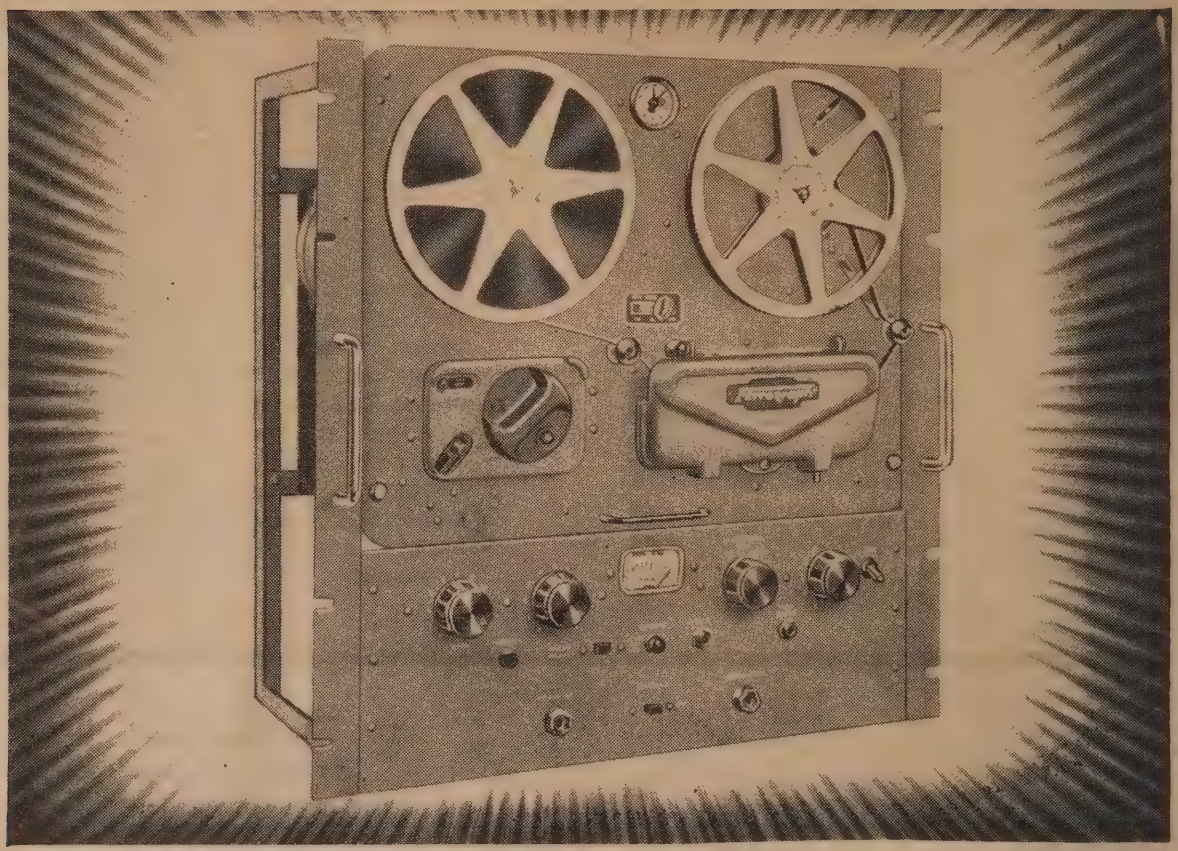

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Model	Tape Speeds	Voltage	Frequency
YD5A	7½, 3¾ and 1⅞ i.p.s.	100/250V	50 c.p.s.*
YD5AH	15 and 7½ i.p.s.	100/250V	50 c.p.s.*
YD5B	7½, 3¾ and 1⅞ i.p.s.	100/250V	50 c.p.s.*
YD5BH	15 and 7½ i.p.s.	100/250V	50 c.p.s.*

*60 c.p.s. to order

Y500 DOUBLE CHANNEL RECORDERS

Model	Tape Speeds	Voltage	Frequency
Y532U	7½, 3¾ and 1⅞ i.p.s.	200/250V	50 c.p.s.
Y532A	7½, 3¾ and 1⅞ i.p.s.	117V	60 c.p.s.
Y532E	7½, 3¾ and 1⅞ i.p.s.	110V	50 c.p.s.
Y522UH	15 and 7½ i.p.s.	200/250V	50 c.p.s.
Y522HA	15 and 7½ i.p.s.	117V	60 c.p.s.
Y522HE	15 and 7½ i.p.s.	110V	50 c.p.s.

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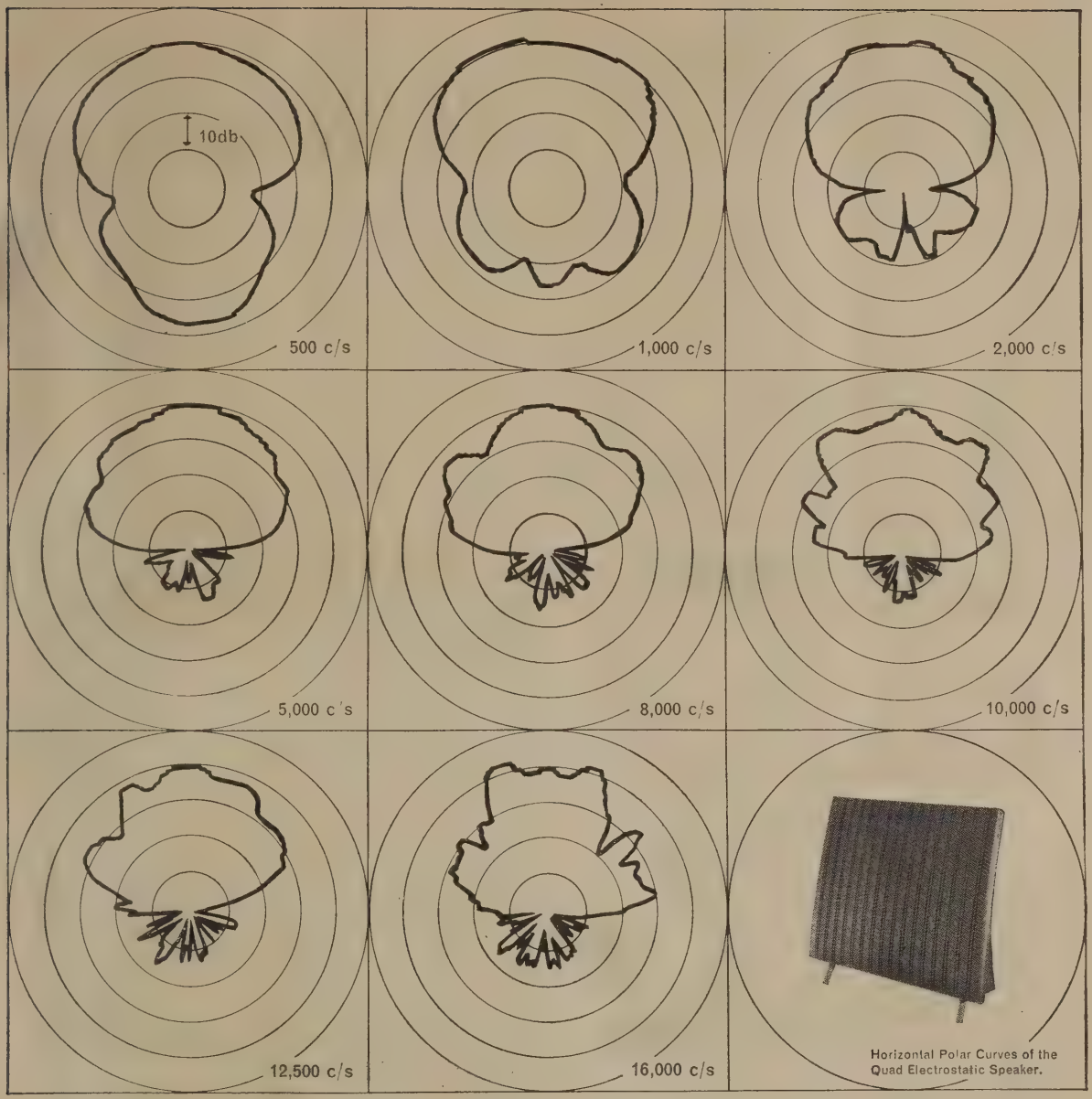

Horizontal Polar Curves of the Quad Electrostatic Speaker.

POLAR CURVES

A good loudspeaker should provide an even distribution over the listening area. It should produce a minimum of output in other directions. There should be no abrupt change of directivity with frequency.

A loudspeaker should be chosen by intelligent listening and not by impressive specifications or curves, even good ones like these. Having made the choice, however, it may be interesting to know one of the reasons why.

QUAD

FOR THE CLOSEST APPROACH TO THE ORIGINAL SOUND

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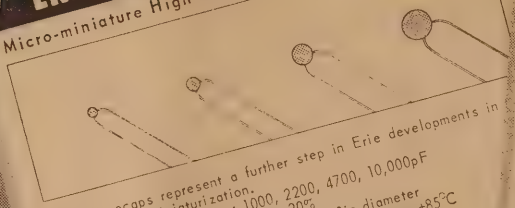
ERIE MICROCAPS

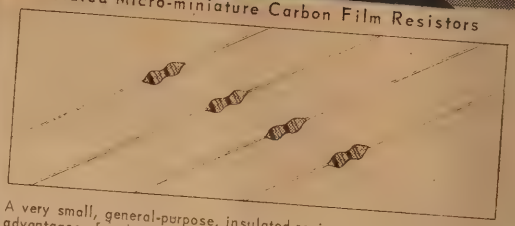
Micro-miniature High Value Disc Ceramicons*



Erie Microcaps represent a further step in Erie developments in the field of micro-miniaturization.
Capacitance : 1000, 2200, 4700, 10,000pF
Tolerance : +80, −20%
Dimensions : 0.08in to 0.20in diameter
Working Volts : 30d.c. at from −40°C to +85°C
Power Factor : 3% max.
Dielectric : K7004
Write for 'Microcap' literature

ERIE EMO

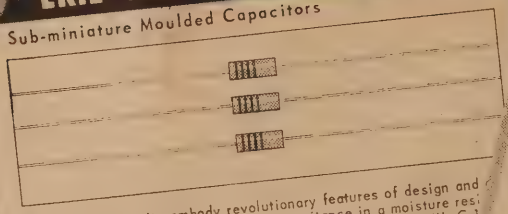
Insulated Micro-miniature Carbon Film Resistors



A very small, general-purpose, insulated resistor incorporating all the advantages of carbon film construction.
Resistance Range : 10Ω to 150,000Ω
Tolerance : ±2%, ±5%, ±10%
Voltage Rating : 70V d.c. max.
Wattage Rating : ⅛W at 70°C
Write for 'EMO' literature

ERIE 390

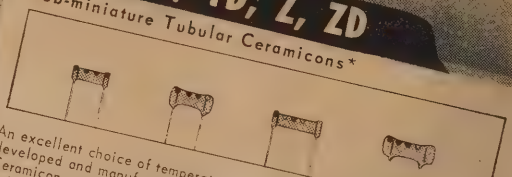
Sub-miniature Moulded Capacitors



Erie Style 390 units embody revolutionary features of design and construction to attain a wide range of capacitance in a moisture resistant moulding. Style 390 meets or exceeds requirements of MIL-C;1
Capacitance : 5.6 to 1200pF
Tolerance : ±10% to +80, −20%
Working Volts : 100d.c. at +85°C
50d.c. at +125°C
Write for 'Style 390' literature

ERIE Y, YD, Z, ZD

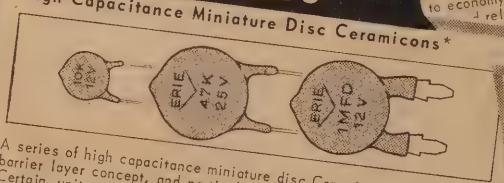
Sub-miniature Tubular Ceramicons*



An excellent choice of temperature compensating and Hi-K dielectrics, developed and manufactured by Erie, gives this sub-miniature tubular Ceramicon range its versatility. The 'D' suffix indicates insulated finish.
Capacitance Range : Y, YD−2pF to 1000pF
Z, ZD−8pF to 1500pF
Tolerance : ±5%, ±10%, ±20% and −20% +50% according to dielectric
Working Voltage : 150V d.c. at from −40°C to +85°C
Dielectric : P100 to Hi-K
Write for Y, YD, Z and ZD literature

ERIE TRANSCAPS*

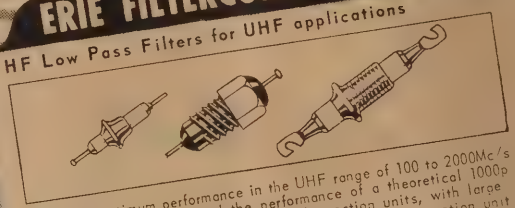
High Capacitance Miniature Disc Ceramicons*



A series of high capacitance miniature disc Ceramicons based on the barrier layer concept, and particularly suited for transistor circuitry. Certain units are also available with Erie Pluggable terminations.
Capacitance Range : 0.01pF to 0.5pF, according to style
Tolerance : −25%, +50%
Working Voltage : 3V, 6V, 12V or 25V d.c. according to style
Operating Temp : −40°C to +85°C
Write for 'Transcap' literature

ERIE FILTERCONS*

HF Low Pass Filters for UHF applications



Providing optimum performance in the UHF range of 100 to 2000Mc/s Erie Filtercons far exceed the performance of a theoretical 1000p capacitor. They are available as single section units, with large small eyelet mounts, as well as in six- and twelve-section unit
Minimum att : 45dB, 200 to 2000Mc/s
50dB, 100 to 2000Mc/s
56dB, 50kc/s to 2000Mc/s
Working Volts : 200, 350 or 500d.c.
Operating Temp : −55°C to +125°C
'Filtercon' literature

ERIE ELECTRONIC COMPONENTS

All illustrations actual size

**Registered Trade Marks*

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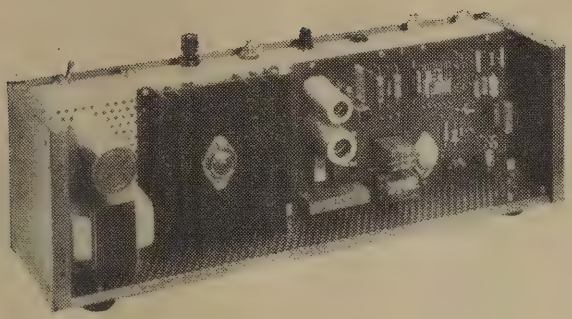
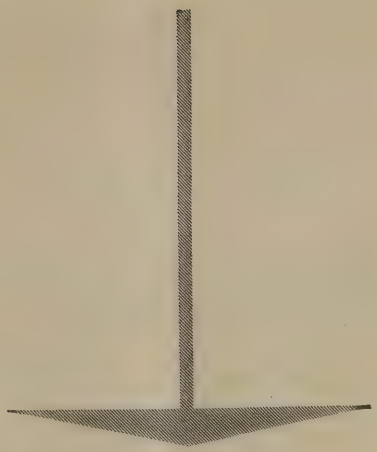
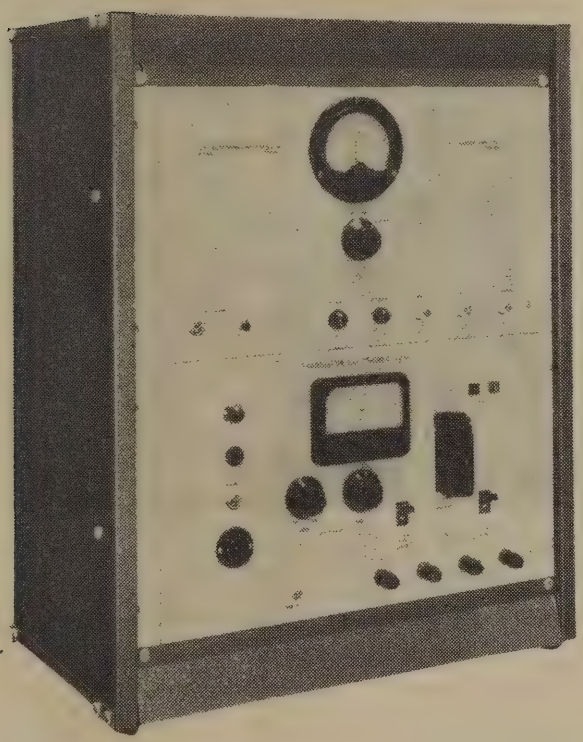




PRELUDE TO PROGRESS



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CHASSIS SYSTEM

Lektrokit provides the perfect base for any experimental chassis, eliminating delays normally associated with prototype work.

All Lektrokit parts are designed so that complex assemblies may be built quickly. Components available include pre-punched chassis plates for valve holders, pre-punched plates for transistor and printed circuit design and a full range of half length components for constructing compact units or test-meters.

Almost every Government Research Establishment and many Commercial Organisations in Great Britain use the Lektrokit system, saving time and money on drawing effort and metal-work.

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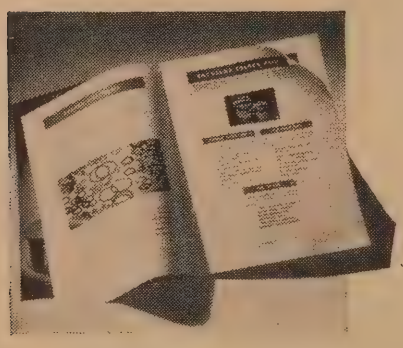
Enthoven solder preforms reduce the percentage of rejects, economise in materials and in manpower.



We will gladly advise on any soldering problem you may encounter. As a first step why not send for our booklet on ENTHOVEN SOLDER PRODUCTS.

A wide range of Enthoven solders, both cored and solid, are available in the form of rings, washers, discs, shims, strips and ribbon, for use with advanced soldering techniques. Special sizes or shapes can always be evolved and precision manufactured to meet individual requirements.

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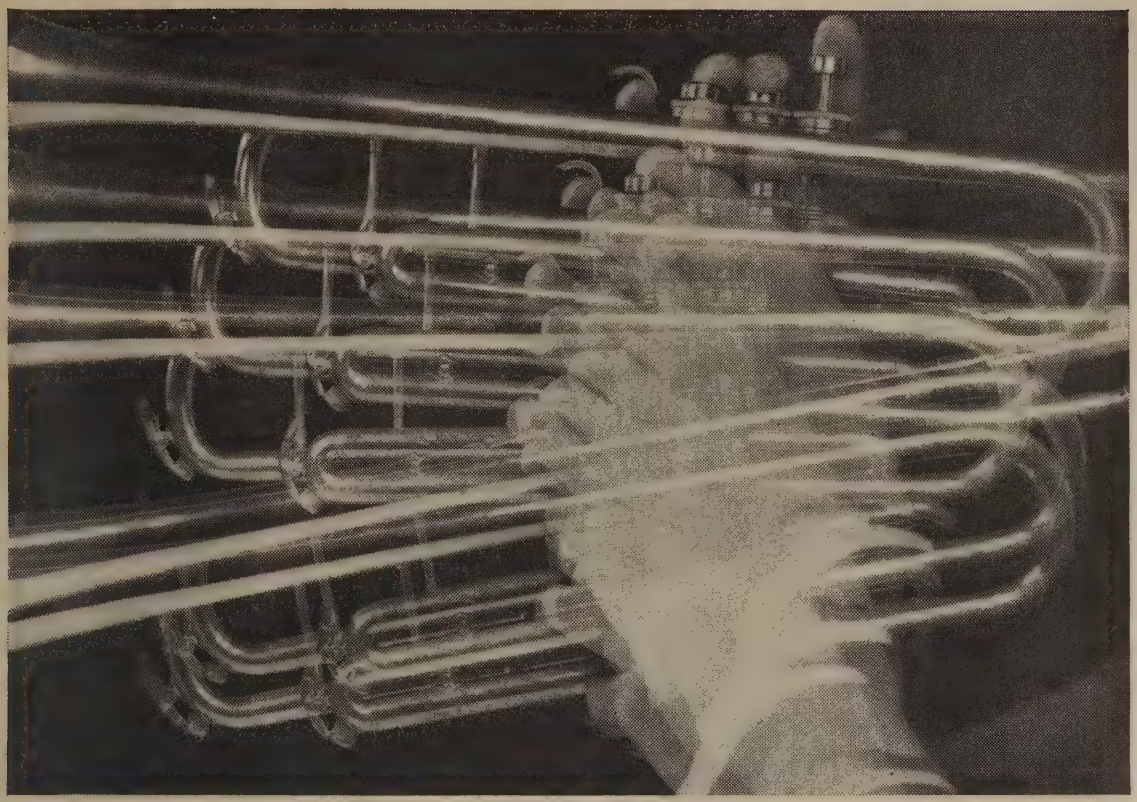
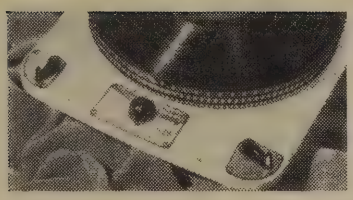
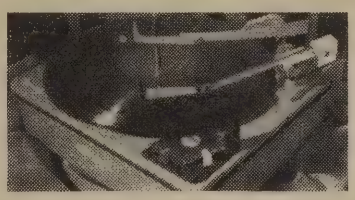


Garrard– sounds of '63

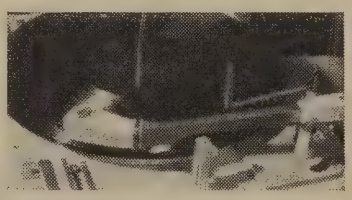
Builders of fine sound reproduction equipment for over forty years, Garrard supply transcription motors and record players to major broadcasting companies all over the world. Even the lowest priced models in the Garrard range are so stringently quality controlled before they leave the factory that they can be compared in performance and appearance to the best in other manufacturers' ranges. The best in the Garrard range are incomparable—take these three, for example:



301. Three-Speed Transcription Motor
The model 301 is used by major broadcasting companies all over the world including the BBC and Radio Luxembourg. It has an extremely low wow and flutter figure and each of the three nominal speeds is adjustable by means of a specially designed eddy current brake. Individual test report, supplied with each unit.



A.T.6 Auto Turntable
A high performance unit which is ideal for manual playing yet embodies automatic selection of all types of records when required. The Model A.T.6 has a heavy turntable with a dynamically balanced tubular aluminium pick-up arm which has the unique Garrard Stylus Pressure Adjustment fitted as standard and is professional in every aspect.



Type 'A' Laboratory Series Auto Turntable
The Type 'A' incorporates a scientifically designed precision mass counterbalanced pick-up arm with inbuilt stylus pressure adjustment and dual channel muting switch and switch click suppressor. A heavy sandwich construction non-magnetic turntable is fitted as standard to provide ideal operating conditions for the most sensitive pick-ups.

Garrard

Write or 'phone for full details of these and other models in the Garrard range.

GARRARD ENGINEERING LIMITED

Swindon · Wiltshire · Telephone: Swindon 5381 (5 lines) · Telex: 44-271

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A miniature Mallory Mercury RM-625 battery provides well over 75 hours of power in the Spectra 'one listener' Radio Spectacles, distributed by New Age Radio, London NW1.

0·2″ high, 0·6″ diameter—that's the size of the Mallory battery that packs *more than 75 hours* listening time into the 'Spectra' Radio Spectacles! Small wonder designers insist on Mallory to give their products life. And not just for miniaturization . . . Mallory batteries will stand continuous current drains without fading for lack of rest, have a high flash current, can lie idle for two years or more without losing energy, without leaking, without corroding. Find out about

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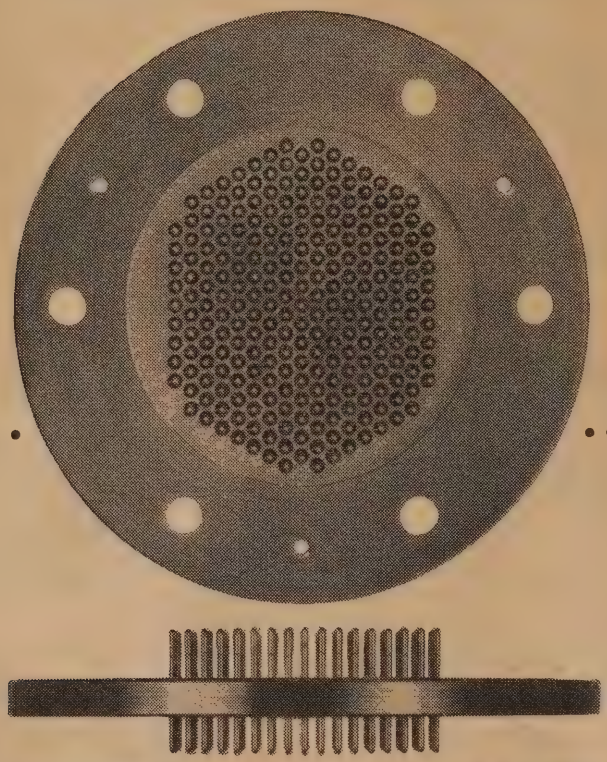
Perfected glass-metal bond give Amphenol-Borg hermetic seals



up to 9000 p.s.i. ultimate strength 390°C. working temperature

Amphenol-Borg glass seals meet a strict definition of hermetic sealing. The leakage rate is less than 0.1 micron cubic foot of helium per hour when checked by mass spectrometer at one atmosphere pressure differential. Sealing has been perfected through a special Amphenol-Borg technique which bonds glass inserts to the steel shells. (The glass seal is, of course, an excellent dielectric). The range of hermetic seals includes receptacles in accordance with MIL-C-5015, MIL-C-26500 and MIL-C-26482. There are designs for seals to operate up to 390°C; with a safe working strength of 3000 p.s.i. differential working pressure and a breaking strength of 9000 p.s.i. at room temperature. All multi-pin Amphenol-Borg hermetic seal connectors have clear contact identification, which assists accuracy and speeds wiring and inspection.

AMPHENOL BORG

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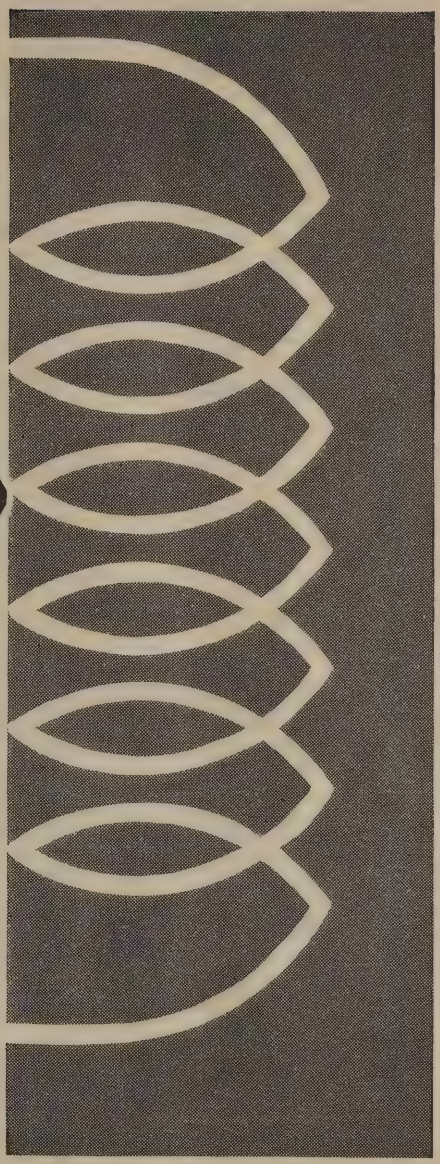

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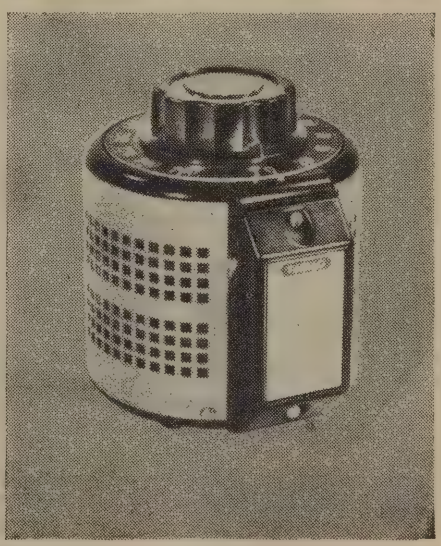

Variac

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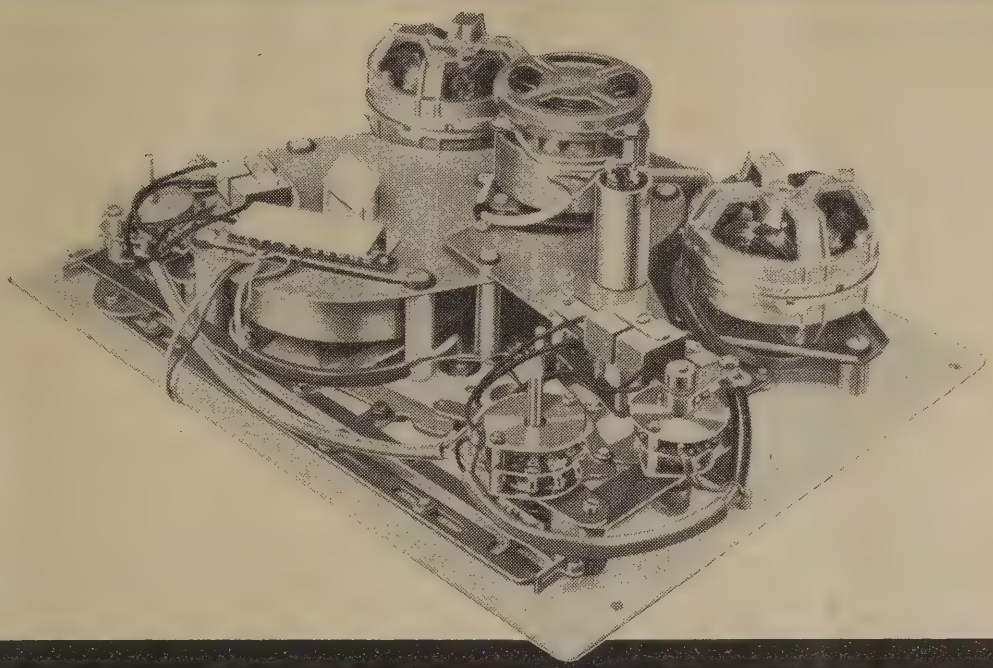

versatile BRENELL tape recorders

Two basic decks are available, the Mark 5 Series 2 for reels up to 8¼in. dia. and the Mark 510 Series 2 for reels up to 10½in. dia. Both types accommodate up to 4 heads—single or multi-track. These decks, having the following notable features, are incorporated in the Mark 5 Series 2, the Type M and the STBI tape recorders.

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- *Four speeds*—1⅞, 3¾, 7½ *and* 15 *i.p.s.*
- *Low "wow" and "flutter" at all speeds.*
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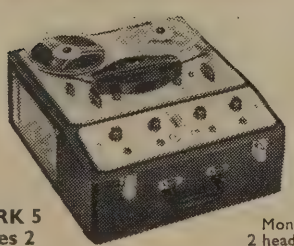
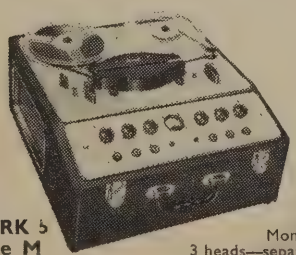


MARK 5 Series 2 Mono—2 heads—record/playback amplifier



MARK 5 Type M Mono—3 heads—separate record and playback amplifiers

STBI Stereo—4 heads—2 recording amplifiers and 2 playback pre-amplifiers

GD583

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FOR

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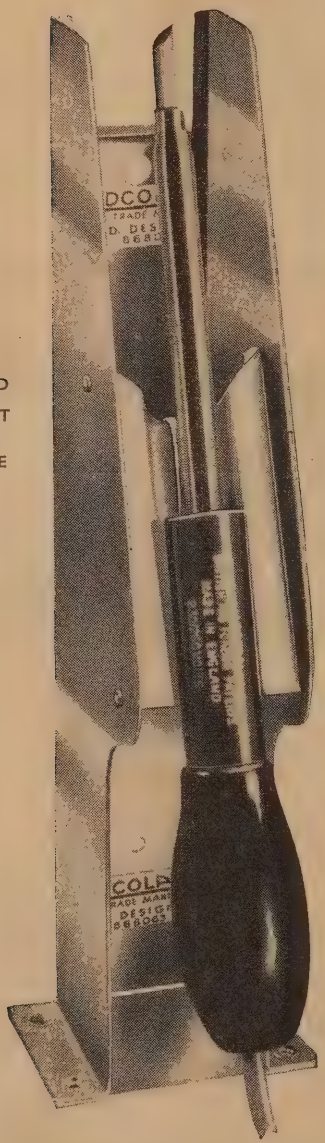

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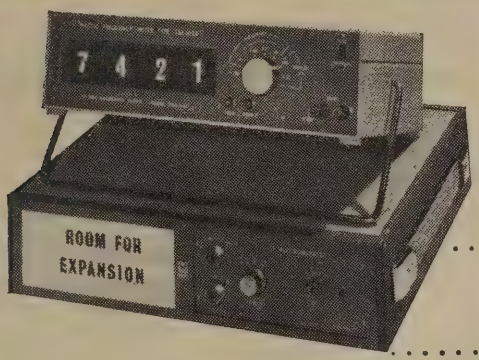

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x 15 ..... £100*

15 Mc/s £250

Take a standard Venner TSA 3334 Frequency Meter—a simpler instrument, but compact and lightweight. Add the same 15 Mc/s Converter—also compact and lightweight. There, for only £250, you have a portable 15 Mc/s meter. *Why pay more?*

** Plinth casing as shown, £10 extra.*

STOP PRESS

50 Mc/s Converter for either instrument now available . . .

only **£250**

ROOM FOR EXPANSION!

The 15 Mc/s Converter, one of a number of auxiliary devices designed by Venner, increases the usefulness of these two transistorised inline readout meters. Write for full details of TSA 3334 and 3336, of the 15 Mc/s Converter, the Variable Trigger Level Unit, the 1 Mc/s Amplifier and the Variable Time Base Unit.

VENNER

VENNER ELECTRONICS LIMITED, Kingston By-Pass, New Malden, Surrey. MALden 2442

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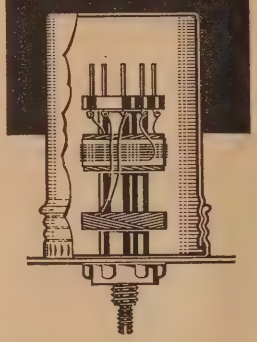
LATEST HIGH QUALITY COMPONENTS FROM THE MAXI-Q RANGE . . . . . .

TESTED AND TRIED OVER 5 FREQUENCY RANGES

TRANSISTOR DUAL PURPOSE COILS



★ Coils for transistor superhets or converters, with or without an R.F. stage and using 465 Kc/s or 1.6 Mc/s. I.F.
★ Noval B9A Based for Plug-in application—Screw threaded for Chassis application.
★ Formers moulded in low-loss polystyrene for best results.
★ Each coil is packed in an aluminium container which may be used as a screening can.
★ Brass threaded adjustable iron-dust cores.

The following colour code identifies the coils:
BLUE — Aerial coil with base input winding.
YELLOW — Interstage R.F. coil with couplings.
RED — Oscillator coil for 465 Kc/s I.F.
WHITE — Oscillator coil for 1.6 Mc/s I.F.

PRICE 4/9d. each

Coverages: Range 1T—.15/.4 Mc/s; 2T—.515/1.545 Mc/s; 3T—1.67/5.3 Mc/s; 4T—5/15 Mc/s; 5T—10.5/31.5 Mc/s.
Full technical details now included in Technical Bulletin DTB.4—**1/6d.**

IFT.13 Miniature 465 Kc/s. I.F. Transformer ..... **7/6d.** each
IFT.14 Miniature 465 Kc/s. Last I.F. Transformer .. **7/6d.** each
IFT.16 Miniature 1.6 Mc/s. I.F. Transformer..... **6/6d.** each
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GENERAL CATALOGUE covering full range of components, send 1/6d. in stamps. PLEASE SEND S.A.E. WITH ALL OTHER ENQUIRIES.

DENCO (CLACTON) LTD., (DEPT. W.W.), 357/9 Old Road, Clacton-on-Sea, Essex

LINEAR

MODEL LI/10 HIGH FIDELITY 10 WATT AMPLIFIER

WITH INTEGRAL PRE-AMPLIFIER

For HIGH SENSITIVITY!
HIGHEST FIDELITY!
MAXIMUM RELIABILITY!
REASONABLE COST! **Also Available**

Size of unit 9 x 7 x 5in. Stoved gold hammered finished chassis. Weight 10lb. For 50/60 c.p.s. A.C. mains 200-230-250 v. or to order for export. A chromium-handled protective cover is available at **19/6.**

13 Retail Price **GNS.**

The following outstanding test figures include pre-amplifier.

Sensitivity (for 10 watts)
L.P. 220 M.V.
78 r.p.m. 220 M.V.
Mic./Radio 40 M.V.

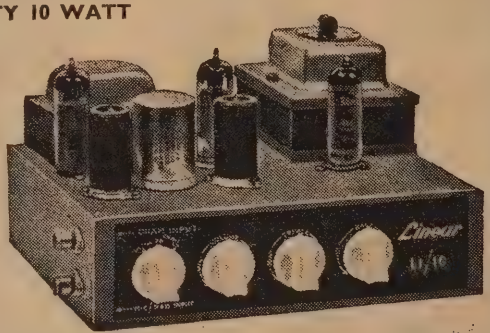
Input Impedance
Gram 100K. Mic./Radio 2 meg.

Frequency Response.
± 1 d.b. 30-20,000 c.p.s.

Power Consumption
90 watts

Maximum Power Output
14 watts

Negative Feedback
21 d b. in main loop.



HARMONIC DISTORTION
(inc. pre-amplifier)
Less than 0.1% measured at 8 watts 1,000 c.p.s.
Damping Factor 39
Bass Control
+ 14 d.b. to — 10 d.b. at 50 c.p.s.
Treble Control
+ 10 d.b. to — 22 d.b. at 12,000 c.p.s.
Hum Level
— 70 d.b.

MULLARD VALVES
ECC83 (2); EL84 (2); EZ81 (1).

OUTPUT MATCHINGS
For 3 ohm and 15 ohm L/Speakers from high-grade sectionally wound output transformer.

RESERVE POWER SUPPLY (for Radio Tuner) 300 v. 30 m.a. smoothed and 6.3 v. 1.5 a. at 4-pin socket.

The L45. Compact High Quality 4-5 watt Amplifier
Size approx. 7-5-5¾in. Sensitivity is 28 millivolts so that the input socket can be used for either microphone or gram. tape, radio tuner, etc. V.B.A. valves used are: ECC83, EL84, EZ80. Controls are: Vo., Treble and Bass with mains switch. The tone controls provide full compensation for long-playing records. Output matching for 3 ohm loudspeaker. Retail price **£5/19/6.**

LPI TAPE PRE-AMPLIFIER. Negative feedback equalisation adjustment by multi-position switch to 1⅞ x 3¾in. and 7½in. per sec. Especially suitable for use with Collaro Studio Transcriptor or Brenell Deck. Attractive black and gold perspex facia plate. Retail price **9 gns.**

DIATONIC 10-14 WATT. High Fidelity amplifier with integral pre-amplifier Retail **12 gns.**

LI0. 10 watt with separate pre-amp. **15 gns.**

CONCHORD 30 WATT. Hi-Fi amplifier with two separately controlled inputs. Retail **16 gns.**

L50 50 WATT AMPLIFIER. Size approx. 14 x 10 x 8in. Sensitivity 25 m.v. Outputs for 3 and 15 ohm speakers. Retail price **22 gns.**

L5/5 STEREOPHONIC AMPLIFIER. Sensitivity 10 m.v. Output 5 watts on each channel. Retail **12 gns.**

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ARMLEY, LEEDS

Tel.: Leeds 63-0126 (3 lines)

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Stentorian

MODEL H.F. 1012 SPEAKER

10in. die-cast unit, incorporating 12,000 gauss magnet. Fitted with cambric cone and universal impedance speech coil providing instantaneous matching, at 3, 7.5 and 15 ohms. Handling capacity 10 watts. Frequency response 30 c.p.s. to 14,000 c.p.s. Bass resonance 35 c.p.s.

Price £4/7/6

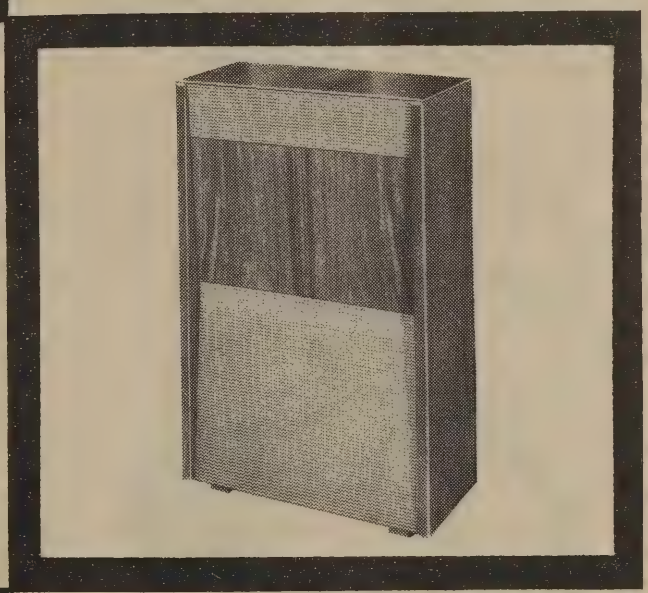
THORESBY SLIM-LINE CABINET

This enclosure has been designed to accommodate any of the Stentorian range of 8in. or 10in. units. Provision is made for the addition of either pressure or cone type tweeter and a crossover may be used.
The cabinet is substantially constructed and acoustically proportioned to give a balanced reproduction with the chosen units. Available in mahogany or walnut. Height 31in. x width 20in. x depth 9¼in.

Price: Mahogany £8/15/- Walnut £9/-/-

BASS REFLEX CONSOLE CABINETS
Height 31in. x width 19⅜in. x depth 18in.
Price: Mahogany £12/12/- Walnut £12/19/6

HI-FI EQUIPMENT CONSOLES
Height 31in. x width 19⅜in. x depth 18in.
Price: Mahogany £14/14/- Walnut £15/4/-



T.359 CONE TWEETER

Provides a very high standard of reproduction when used in conjunction with "Stentorian" 10in. or 12in. units. Incorporates High Sensitivity 9,000 gauss magnet, special cone and lightweight coil.
Frequency response: 3,000-15,000 c.p.s. Overall size: 3in. dia. x 2in. deep. Voice coil impedance: 15 ohms or 5 ohms. Power handling capacity: 15 watts when used with a 3,000 c.p.s. crossover.

Price £1/10/6

Supplies of leaflets on all Whiteley products available on request.

WHITELEY ELECTRICAL RADIO CO. LTD · MANSFIELD · NOTTS

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silicon or germanium

1964 logic design uses modules

Ferranti Ltd. have further extended the range of their encapsulated logical circuit elements by the introduction of the 300 S series, with silicon semiconductor active elements, designed to operate on standard supply voltages of 12 volts, 6 volts and 6 volts bias, quite wide tolerances being allowable on these figures.

The form of construction used for these elements — their plan area is less than that of a shilling piece — allows a high density packaging and wide flexibility of circuit arrangement, whilst retaining the high reliability factor of individual conventional components.

- Bistable flip-flop circuits
- 5 Input 'And' blocks
- 5 Input 'Nand' blocks
- 5 Input 'Or' blocks
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- Variable frequency multivibrators
- Variable period monostable circuits
- Quadruple emitter follower units
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WILL OPERATE IN AMBIENT TEMPERATURES UP TO 100°C

WILL SWITCH IN EXCESS OF 3 Mc/s

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First into the Future

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FERRY ROAD, EDINBURGH 5
Telephone DEAn 1211

ED/T1

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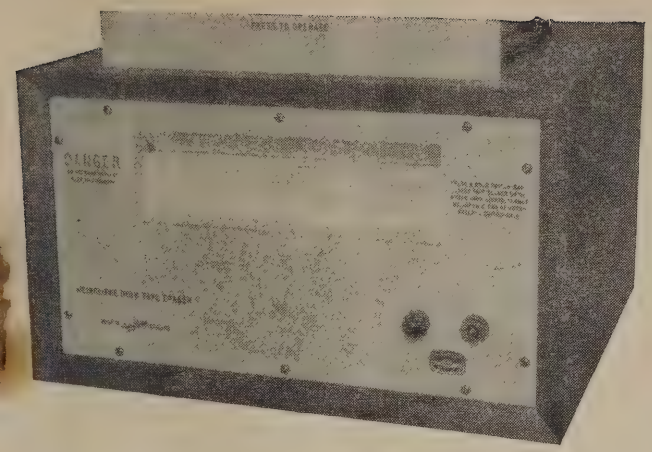

WEIRCLIFFE

MAGNETIC TAPE BULK ERASER

The Weircliffe Bulk Tape Eraser has been designed for the professional and semi-professional users of magnetic tapes who require a fast and foolproof method of erasing all matter from complete reels of tape.

Tapes are 'cleaned' instantly by insertion of the reel or cassette into the receiving slot of the eraser. Spring loaded guides and reject mechanism enable tapes to be cleaned at the rate of 10 seconds per tape. A combined switch gate ensures that the instrument is only operational during the cleaning of each tape, so that there is no limit to the number of tapes which may be consecutively erased.

All recorded matter, whether speech, music or marker pulses is completely removed during cleaning and no background or hum remains. Tapes which are completely saturated are cleaned equally effectively. As the 'cleaning' flux extends over the whole area of the reel or cassette, the amount of tape on the reel is of no consequence.

Two standard models are available, Model 6 being suitable for reels having a diameter of $8\frac{1}{2}$", 7", $5\frac{3}{4}$" and 5", while Model 7 accepts commercial $6\frac{3}{4}" \times 8"$ continuous tape cassettes. Both models are housed in attractive yet rugged mahogany cases impregnated with clear Melamine to withstand hard wear. The panel and interior fittings are in white Perspex and operating instructions are permanently marked on the panel.

The normal operating voltage range is 200V/240V 50 c.p.s., but erasers can be supplied to order for any voltage.

Dimensions: $11\frac{1}{2}" \times 12\frac{1}{4}" \times 7\frac{1}{2}"$

Weight: 43 lbs.

Current consumption (intermittent)—approx. 12 Amps.

Available shortly: Model 8 accepting $10\frac{1}{2}$"-14" reels of $\frac{1}{4}$"-1" tape.

If YOU use magnetic tape, you cannot afford to be without the

WEIRCLIFFE BULK ERASER

Designed & Manufactured by

AMOS OF EXETER LTD.

WEIRCLIFFE COURT · EXWICK · EXETER · ENGLAND

TELEGRAMS: AMOS EXETER

TELEPHONE: EXETER 72132

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...hms
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...monitor output
...ously
...ETT IN U.K. £230

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...ER SUPPLY
...ument is similar to the PP2,
...t the output is 0 to 80V, 6A
...ETT IN U.K. £235

...ABILISED D.C. SUPPLY
...ES
...endent Supplies, 0 to 30V,
...overlapping ranges
...ange less than 3mV for
...put Change
...pple less than 1mVp.p.
...C. Resistance less than

...pedance at 100kc/s less
...hm
... and 4-range Ammeter
...o monitor either output
...ETT IN U.K. £175

This wide range of Stabilised DC Power Supplies is designed for the development and testing of thermionic valve and semi conductor circuitry. Attractively styled they have an excellent performance, high stability and are offered at very competitive prices.

PP3

TWIN STABILISED D.C. SUPPLY

FEATURES

Two Independent Supplies, 0 to 30V, 1A, in three overlapping ranges

Output Change less than 10mV for ±7% Input Change

Output Ripple less than 0·5mVp.p.

Output D.C. Resistance less than 0·01 ohms

Output Impedance at 100kc/s less than 0·2 ohms

Voltmeter and 2-range Ammeter switched to monitor either range

PRICE NETT IN U.K. £110

PP1

LABORATORY POWER SUPPLY

Following the general styling of this series of instruments, the PP1 is designed primarily for thermionic valve circuitry

FEATURES

1. 0-600v. D.C. Stabilised 300mA
2. 100-800v. D.C. Unstabilised 300mA
3. -200v. D.C. Stabilised 50mA
4. 0-200v. D.C. 5mA
5. 2 6·3v A.C. Stabilised Supplies 4 Amps each. Stabilisation factor of outputs 1, 3 and 4 1000:1

Maximum ripple voltage
1 and 2 3mV
3 and 4 1mV

PRICE NETT IN U.K. £175

PP5

TRANSISTORISED LABORATORY POWER SUPPLY

A transportable, power supply weighing only 8 lb, fitted with bipod and carrying handle

FEATURES

Output 0 to 15V, 500mA max.

Output Change less than 12mV for +5% to —10% Input Change

Output Ripple less than 0·5mVp.p.

Output D.C. Resistance less than 0·01ohms

Output Impedance at 100kc/s, less than 0·2 ohms

Switched dual range meter

PRICE NETT IN U.K. £50

Detailed specifications of each model are available on request.

Advance

AV/1

ADVANCE COMPONENTS LIMITED
INSTRUMENT DIVISION
Roebuck Road, Hainault, Ilford, Essex. Telephone: Hainault 4444

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INVITATION
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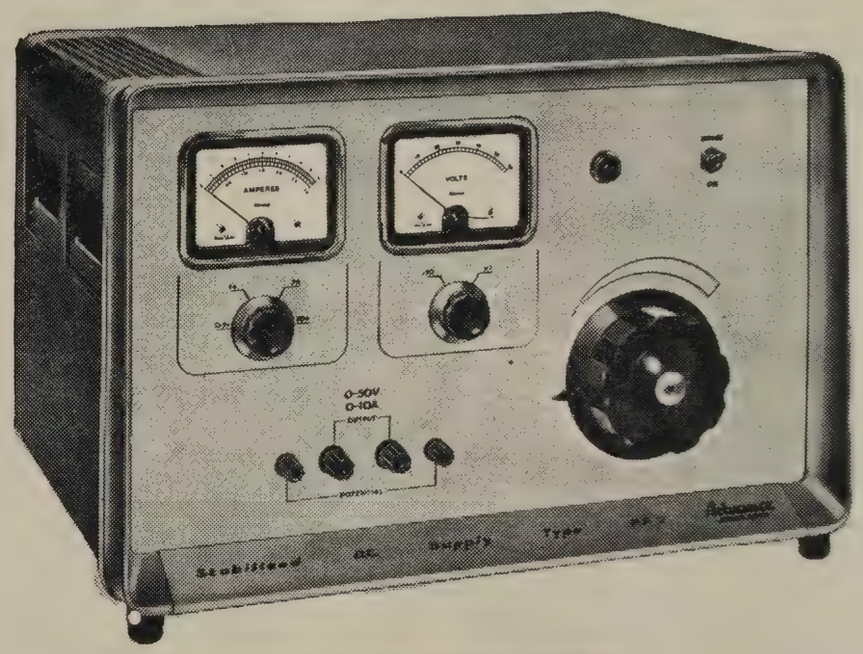
laboratory power supplies



PP2
LABORATORY STABILISED D.C. POWER SUPPLIES
FEATURES
Output 0 to 50V D.C., 10A max.
Output Change less than 3mV for ±15% Input Change
Output Ripple less than 0·5mV p.p.
Output D.C. Resistance less than 3 milliohms
Output Impedance at 100kc/s less than 0·2 ohms
2-Range Voltmeter and 4-range Ammeter monitor output simultaneously
PRICE NETT IN U.K. £230

PP4
LABORATORY STABILISED D.C. POWER SUPPLY
This instrument is similar to the PP2, except that the output is 0 to 80V, 6A
PRICE NETT IN U.K. £235

PP6
TWIN STABILISED D.C. SUPPLY
FEATURES
Two Independent Supplies, 0 to 30V, 3A in six overlapping ranges
Output Change less than 3mV for ± 15% Input Change
Output Ripple less than 1mVp.p.
Output D.C. Resistance less than 0·02 ohm
Output Impedance at 100kc/s less than 0·2 ohm
Voltmeter and 4-range Ammeter switched to monitor either output
PRICE NETT IN U.K. £175

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PP3

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FEATURES

Two Independent Supplies, 0 to 30V, 1A, in three overlapping ranges

Output Change less than 10mV for ±7% Input Change

Output Ripple less than 0·5mVp.p.

Output D.C. Resistance less than 0·01 ohms

Output Impedance at 100kc/s less than 0·2 ohms

Voltmeter and 2-range Ammeter switched to monitor either range

PRICE NETT IN U.K. £110

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3. -200v. D.C. Stabilised 50mA
4. 0-200v. D.C. 5mA
5. 2 6·3v A.C. Stabilised Supplies 4 Amps each. Stabilisation factor of outputs 1, 3 and 4 1000:1

Maximum ripple voltage
1 and 2 3mV
3 and 4 1mV

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TRANSISTORISED LABORATORY POWER SUPPLY

A transportable, power supply weighing only 8 lb, fitted with bipod and carrying handle

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Output 0 to 15V, 500mA max.

Output Change less than 12mV for +5% to —10% Input Change

Output Ripple less than 0·5mVp.p.

Output D.C. Resistance less than 0·01ohms

Output Impedance at 100kc/s, less than 0·2 ohms

Switched dual range meter

PRICE NETT IN U.K. £50

Detailed specifications of each model are available on request.

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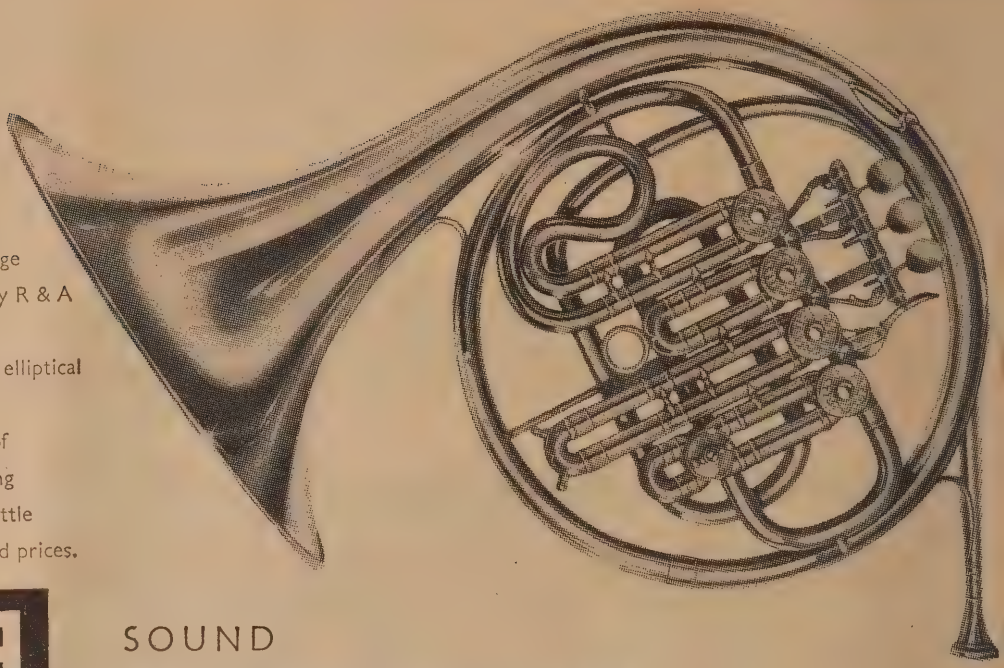

A brilliant new range
of small speakers by R & A
3″ x 3⅜″ round
6″ x 4″ and 8″ x 5″ elliptical
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higher fidelity at little
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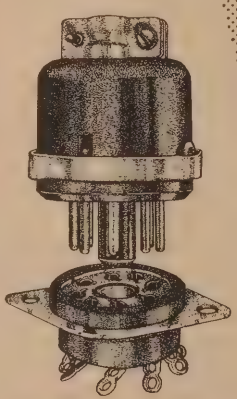

McMurdo Precision Components

McMurdo Instrument Co Ltd
Rodney Rd., Portsmouth, Hants.
Tel. Portsmouth 35555. Telex 8612
Contact our Sales Office for details of our full range

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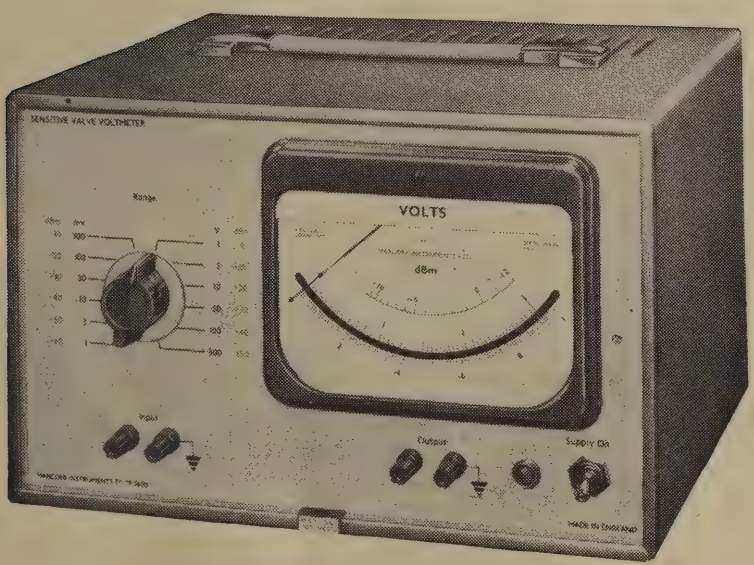
When your work is worthy of the world's finest instruments . . .

Marconi Instruments Type TF 2600 SENSITIVE VALVE VOLTMETER



* Measures from less than 0.1 mV to 300 V in 12 ranges
* Frequency Range: 10 c/s to 5 Mc/s with a useful response to 10 Mc/s
* Excellent discrimination
* Accuracy ± 1% of full scale to 500 kc/s, ± 5% to 5 Mc/s
* Input resistance: 10 MΩ
* Can be used as a wideband amplifier
* Price: £115

Marconi Instruments provide a comprehensive range of high-grade instruments for voltage measurement. Here are some of them:-

TF 1375 A.C. Microvoltmeter
50 c/s to 200 kc/s. 10 μV to 15 V.

TF 1371 Wide Range Millivoltmeter
30 c/s to 30 Mc/s. 300 μV to 300 mV a.c.
Optional × 10 and × 100 multipliers.

TF 899A Valve Millivoltmeter
50 c/s to 100 Mc/s. 20 mV to 2 V a.c.

TF 1300 Vacuum Tube Voltmeter
0.05 to 100 V, 30 c/s to 300 Mc/s.
0.1 to 300 V d.c. 50 Ω to 5 MΩ.
Optional × 10 a.c. multiplier.

TF 1041C Vacuum Tube Voltmeter
25 mV to 300 V, 20 c/s to 1,500 Mc/s.
10 mV to 1,000 V d.c. 0.02 Ω to 500 MΩ.
Optional voltage multipliers.

TF 1377 Suppressed Zero Voltmeter
0-500 V d.c. and small changes down to 1 mV in 100 V.

Please address your enquiries to **Marconi Instruments Limited** at your nearest office

A GOOD NAME FOR GOOD MEASURE

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English Electric House, Strand, London, W.C.2.
Telephone: COVent Garden 1234
40 Whiteladies Road, Bristol, 8. Telephone: Bristol 39639
23/25 Station Square, Harrogate, Telephone: Harrogate 67454

Head Office—Home and Export Sales:
St. Albans, Herts., England. Telephone: St. Albans 59292

MARCONI INSTRUMENTS

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THE LARGEST
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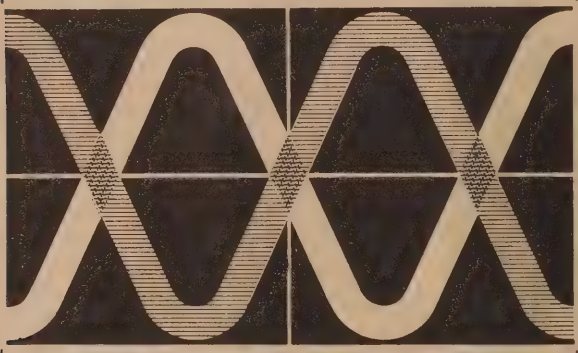
From FEBRUARY 7th to 12th, 1964

IN PARIS, PORTE DE VERSAILLES

at
THE INTERNATIONAL
EXHIBITION OF

ELECTRONIC



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All components, tubes and
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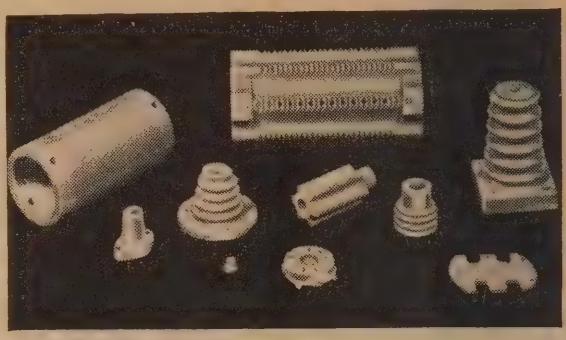
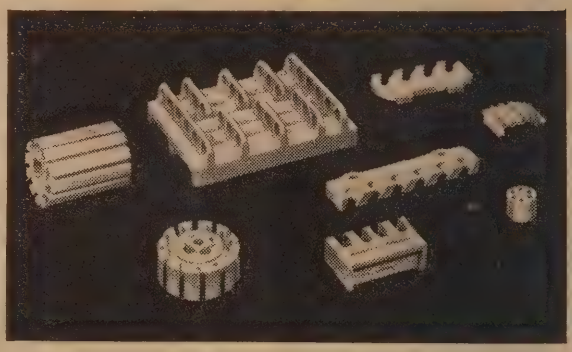
Bullers CERAMICS

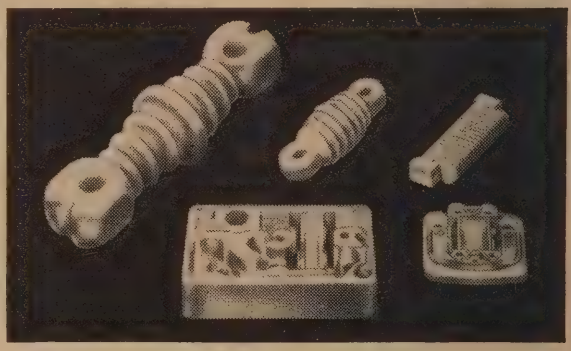
for the **ELECTRONIC INDUSTRY**
(and Electrical Appliance Manufacture)



Frequelex—for high-frequency insulation.



Refractories for high-temperature insulation.



Bullers porcelain for general insulation purposes.

Meticulous care in manufacture, high quality material, with particular attention applied to *dimensional precision and accuracy*, explain the efficiency and ease of assembly when using Bullers die pressed products. *Write today for detailed particulars.*

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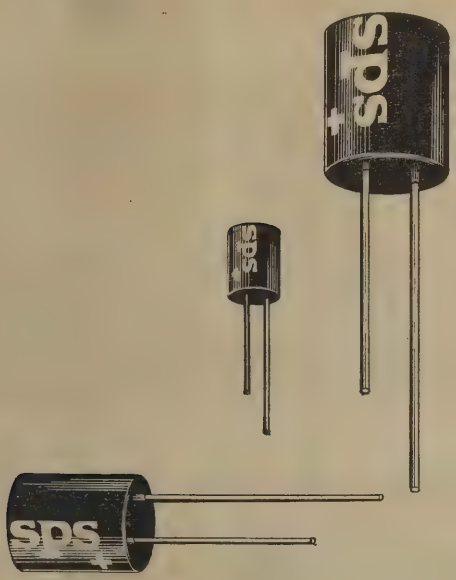

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CAPACITANCE—20% + 100% of rated capacity

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OPERATING TEMPERATURE: 65°C at rated WVDC

Available in 42 standard ratings, with intermediate values at no extra cost. For complete technical information and assistance write or telephone SPS International Ltd., European manufacturing arm of a leading U.S. supplier of quality capacitors.

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Telephone: Shannon 245

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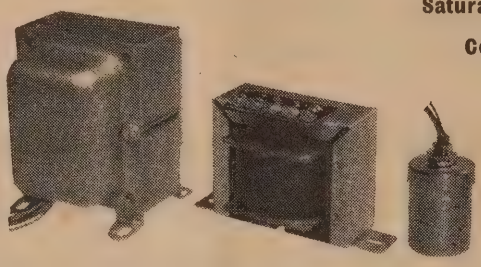

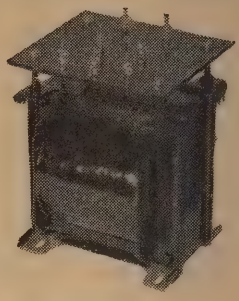

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48 sq. in.	4/-	176 sq. in.	8/-	304 sq. in.	12/-
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112 sq. in.	6/-	240 sq. in.	10/-	368 sq. in.	14/-
144 sq. in.	7/-	272 sq. in.	11/-	and pro rata.	
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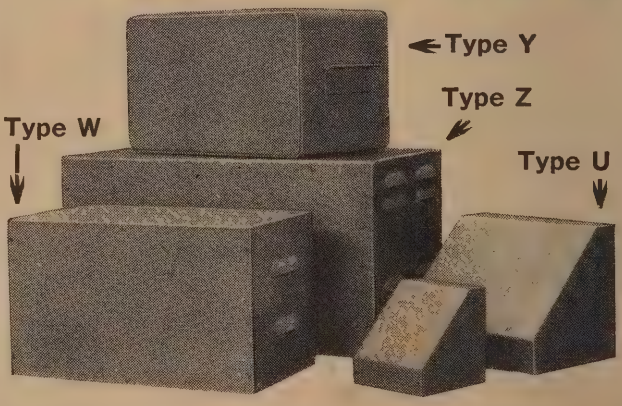
Discounts for quantities. Finishes arranged for quantities of 25 or over.

FLANGES (¼in., ⅜in.), 6d. per bend.
STRENGTHENED CORNERS 1/- each corner.
PANELS: Any size up to 3ft. at 4/6 sq. ft 18 s.w.g.; (16 s.w.g. 5/3). Plus post and packing, over £2 free



CASES

ALUMINIUM, SILVER HAMMERED FINISH

Type	Size	Price	Type	Size	Price
U	4 x 4 x 4*	9/6	Y	8 x 6 x 6*	25/-
U	5½ x 4½ x 4½	14/6	Y	12 x 7 x 7	39/-
U	8 x 6 x 6	20/-	Y	13 x 7 x 9	44/-
U	15 x 9 x 9	42/6	Y	15 x 9 x 7	46/-
W	8 x 6 x 6	19/6	Z	17 x 10 x 9	63/-
W	12 x 7 x 7	32/6	Z	19 x 10 x 8½	67/6
W	15 x 9 x 8	42/-	*Height.		

Plus post and packing (over £2 free).

Type U has removable bottom or back, Type W removable front, Type Y all-screwed construction, Type Z removable back and front.

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A NEW RANGE OF TUNERS AND AMPLIFIERS from Armstrong

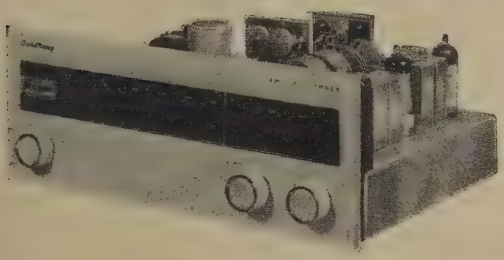
224 FM TUNER

223 AM-FM TUNER (illustrated)

Self-powered with full provision, including space on the chassis, for simply plugging in an Armstrong Stereo Multiplex Decoder when regular stereo transmissions begin. Featuring precision tuning meter, dual audio outputs with pre-set gain control on each, and exceptional sensitivity. The styling of the 224 is similar to the 223 as illustrated. The 223 AM-FM Tuner is identical in performance to the 224 but with the addition of the medium waveband.

Price: 224—£22.10.0

Price: 223—£28.15.0



Continuing in the tradition of high quality with economy, Armstrong introduce a NEW Integrated Stereo Amplifier designed for the Decca Deram and other high-quality ceramic pick-ups.

222 INTEGRATED STEREO AMPLIFIER

Providing 20 watts power output and facilities for radio tuners, tape recording and playback and for any ceramic or crystal pick-up. Suitable for use as the basis of an extremely good yet relatively inexpensive high fidelity system.

Price: £27.10.0

222 SPECIFICATION

Power Output—10 watts per channel.
Frequency Response—30-20,000 c.p.s. ± 1 db.
Distortion—Less than 0.5% at 8 watts.
Loudspeaker Output Impedance—4, 8 and 16 ohms.
Sensitivity—80 mV.
Rumble Filter— —6 db. at 35 c.p.s.
Controls—Selector, Volume, Balance, Treble, Bass.

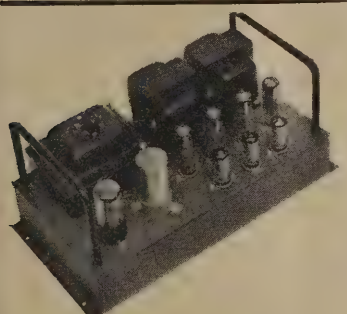
224 SPECIFICATION

Coverage—87-108 M/cs.
Sensitivity—1.5μV for 20 db quieting.
Output—0-2 volts variable to match any amplifier or tape recorder.
Stages—R.F. Stage. Two IF Amplifiers, Limiter Stage and Foster Seeley Discriminator.

223 SPECIFICATION

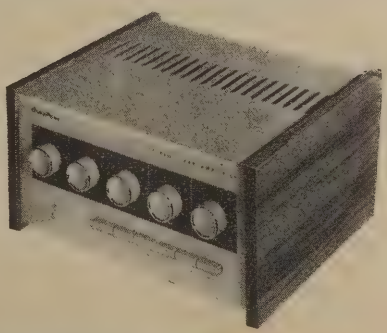
FM Band—as the 224 above.
AM Band
Coverage—180-600 metres.
Sensitivity—5μV for 20 db quieting.
Automatic Variable selectivity—2 to 8 K/cs. depending on signal strength.
Filter—Built in Heterodyne rejection filter.

Optional cases of teak and vinyl-hide as the 225 illustrated below are available for all models.



220 STEREO POWER AMPLIFIER
Price £24.18.0

225 STEREO PRE-AMPLIFIER
Price £22.12.0



Re-styled versions of the A20 amplifier and PCU 25 Pre-Amplifier to match the new Armstrong Tuners. The specifications remain the same.

Full descriptive literature available from Dept. No. WJA/T.

ARMSTRONG AUDIO LTD. Warlters Road, London, N.7. Telephone: NORth 3213

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NEW FANE 12" HEAVY DUTY LOUDSPEAKER MODEL 122/10

2" VOICE COIL — 10,000 GAUSS — 20 WATTS R.M.S.

RETAIL PRICE **5 gns.**

This latest addition to the FANE range of heavy duty loudspeakers permits Hi-Fi on the slenderest budget.

Standard input impedance is 15 ohms but, like all FANE heavy duty speakers, these units can be supplied with special bi-filar wound voice coils, if requested, giving a 4 ohm input impedance without the usual loss in efficiency.

The Model 122 10 is normally built with a main resonance of 40 c.p.s. for general use as a bass reproducer. All FANE 12in. units can be supplied with a cone giving a resonance of 70 c.p.s. for use with electric lead or rhythm guitars for which it is very suitable. Please state which resonance is required when ordering. It should be noted that Fane Heavy Duty loudspeakers have pole pieces of larger diameter than is usual. This results in a substantial increase in total flux with a proportionate increase in efficiency. When compared with speakers of same Flux Density but with the usual diameter pole pieces due allowance should be made for this.

Manufacturers enquiries direct to

FANE ACOUSTICS LIMITED

HICK LANE — BATLEY — YORKSHIRE

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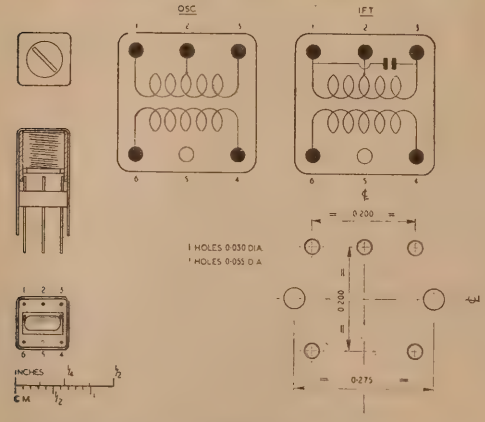
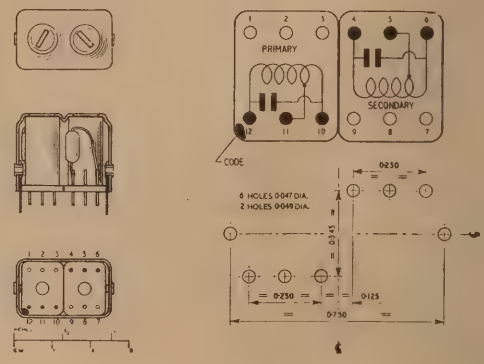


TYPE PI0

Oscillator Coils and Single-tuned I.F. Transformers 7 x 7 x 11 mm.
Osc. Coils cover medium wave with 85 pF capacity swing.
I.F.s for 470 Kc/s operation.

Versions for most types of Transistors are in production.



TYPE T80

Double-tuned 1st and 2nd I.F. Transformers 21 x 13 x 18 mm.
T81 1st I.F. "Q" 85.
T82 2nd I.F. "Q" 100.
Coupling for each type—critical.

Samples and prices available to bona fide manufacturers on request.

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Marconi Instruments

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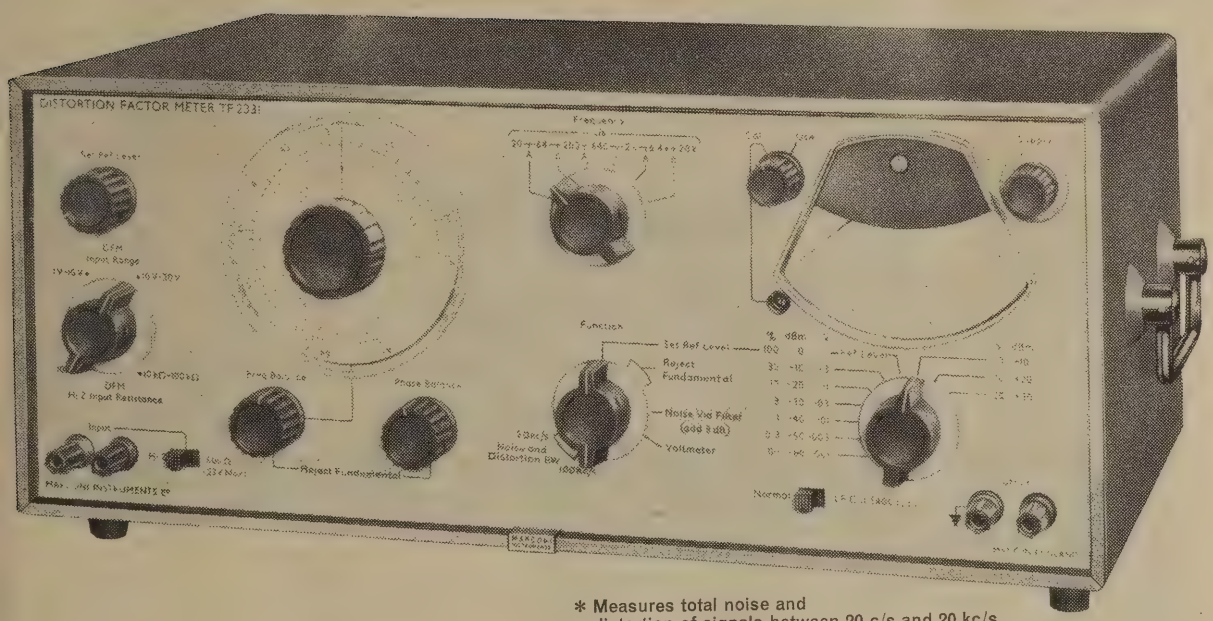
fully transistored for mains or battery operation

DFM

Distortion Factor Meter Type TF 2331



* Measures total noise and distortion of signals between 20 c/s and 20 kc/s.
* Fundamental rejection filter is tunable over 6 bands and provides at least 80 dB suppression.
* Amplifier incorporates filters which are switchable—to provide bandwidths of 20 kc/s or 100 kc/s; to give an l.f. cut below 400 c/s eliminating hum components; or to produce C.C.I.F. type broadcast weighting.
* Seven ranges for noise and distortion between 0.1% and 100% f.s.d., instrument noise and distortion being only 0.02% and 0.025% respectively.
* Meter provides ten ranges of voltage measurement between 1 mV and 30 V f.s.d. with dBm scaling between -72 and +32 into 600Ω.
* Rack-mounting version available.

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TC249

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T.V. CAMERAS

BRAND NEW, TESTED AND READY TO USE

DELIVERY FREE IN U.K.

★ Size 8½ x 3½ x 4¼in. Weight 4 lb.

★ Simple to use. Tune to any Channel 1-5 on Band 1. Fully transistorised.

★ Just plug into mains and take co-ax aerial link from Camera to Receiver. Nothing to adapt.

★ Will take any " C " mount Cine Camera Lens. Works in normal light.

THIS CAMERA WILL BE IDEAL FOR USE WITH VIDEO RECORDERS EXPECTED ON THE MARKET THIS YEAR.

YOU WILL BE ABLE TO STORE YOUR CAMERA RECORD ON TAPE. ITS FANTASTIC.

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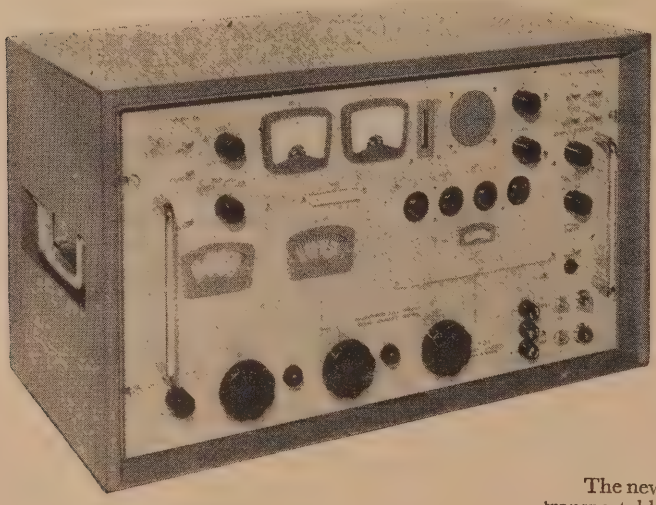

over the temperature range

THE NEW TELEMAX - SOUTHERN T.D.I. FREQUENCY METER HAS THIS SPEC.

Frequency Range	
Fundamental Frequency:	30 Mc/s. to 93 Mc/s.
Internally Converted Range:	D.C. to 30 Mc/s.
Range as a Frequency Meter:	10 Kc/s to 3 000 Mc/s.
Range as a Generator:	D.C. to 3,000 Mc/s.
Reference Standard Stability:	At constant ambient ± 4 parts in 10^9
Accuracy after warming up:	better than 2 parts in 10^8
Fundamental Frequencies - 30 to 93 Mc/s.	> 200 mV minimum.
Sensitivity in Fundamental Range	
D.C. to 30 Mc/s:	5 mV with magic eye zero beat indication
30 to 93 Mc/s:	50 μV using head-phones for zero beat indication.

Standard frequencies of 10 Kc/s, 100 Kc/s, 1 Mc/s and 5 Mc/s are available at crystal accuracy on front panel at approximately 1 volt level.
Optional extra:-
A built-in counter can be supplied.

The new Telemax-Southern T.D.I. Frequency Meter is the only transportable instrument that measures and produces frequencies up to 3,000 Mc/s. with crystal stabilities of the order of 4 parts in 10^9 at constant ambient. It is also available with an optional extra counter unit which allows readings to crystal accuracy ± 1 cycle.

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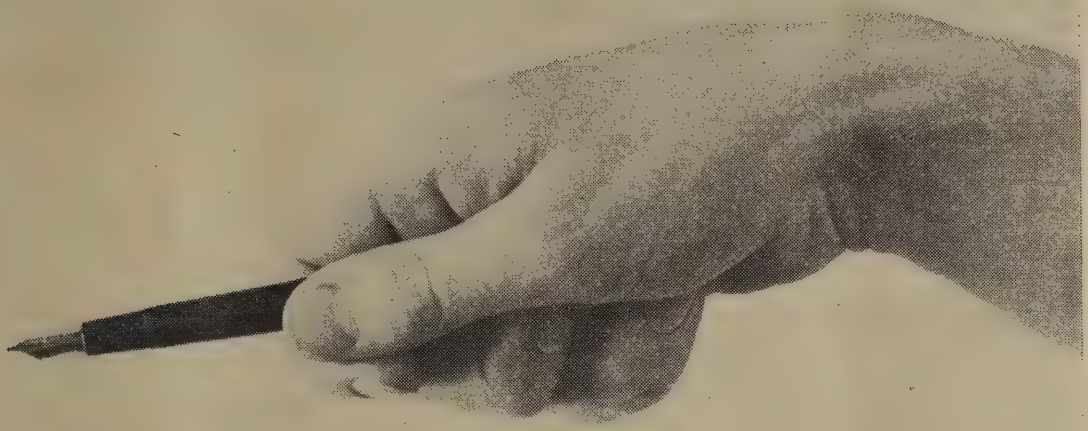

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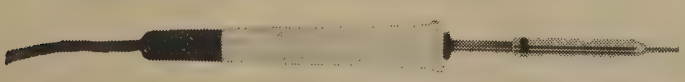
A Precision iron, with its sculpted, balanced handle, makes joints as neatly and accurately as dotting an 'i' or crossing a 't'. On the production line, the Precision method means reduced operator fatigue, increased speed and efficiency. **Fast heat-up.** Here's another performance-plus: the heating element of a Precision iron extends right up into the high conductivity bit for double-quick heating on half the power. No less than 39 bits are available with a choice of 3 bit shapes in most sizes. For more specific information or advice write:



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Separate record and replay heads

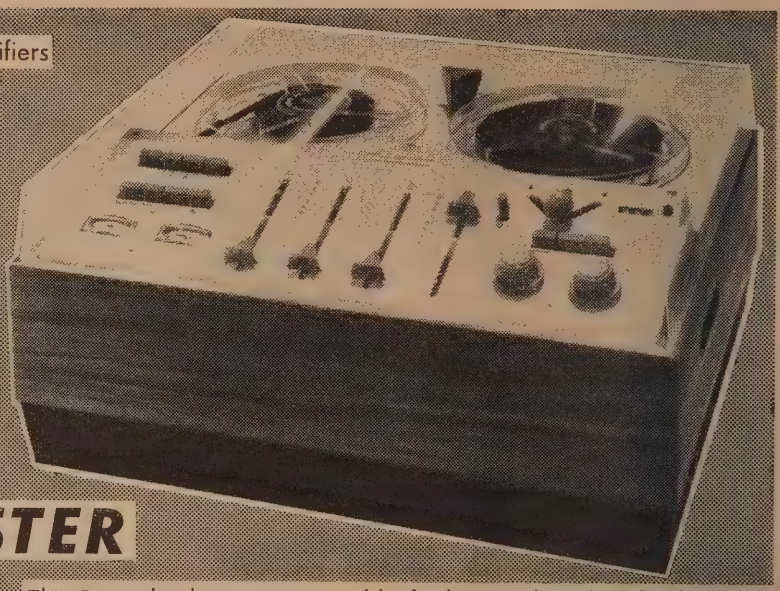
Mixing, monitoring, echo etc.

8 watts per channel

Synchronous motor

Stereo or Mono

3 speeds



The STEREOMASTER

This Recorder has every possible facility combined with elegance, lightness and a High Fidelity performance. Available in an attractively styled teak cabinet (as illustrated) or as a suitcase model (weight only 33 lbs.). Both types available as 2 or 4 track models.

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AUDIO DIVISION

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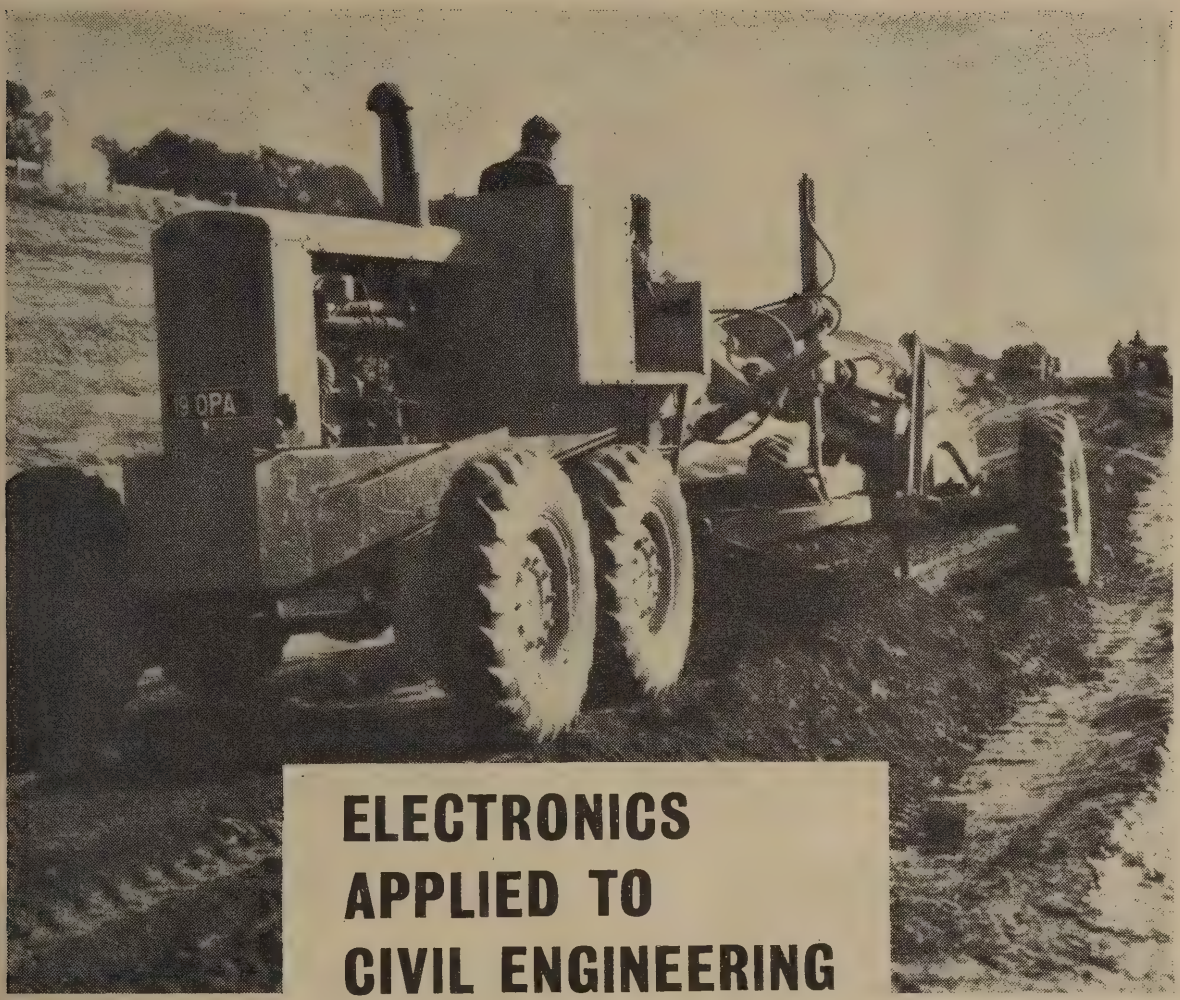

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Automatic blade angle control on motor-graders during construction of roads and airfields, when the ground has to be shaped to a prescribed slope, is described in December INDUSTRIAL ELECTRONICS, now on sale—one of many articles showing how electronics can cut costs and increase productivity in all kinds of industrial process. INDUSTRIAL ELECTRONICS is vital to all who must use electronics to meet ever-increasing competition. Other articles in the current issue are summarised below; January issue will contain *Vibration Measurement on Turbine Blades.*

ALSO IN DECEMBER ISSUE:

TEST RIGS FOR TORQUE CONVERTERS

This article describes equipment which offers important advantages in testing motor-car gear-boxes and differentials, and other forms of torque converter. Electric motors provide drive power and simulate the load. For routine testing the apparatus can be set up to work automatically; for research it can be manually controlled.

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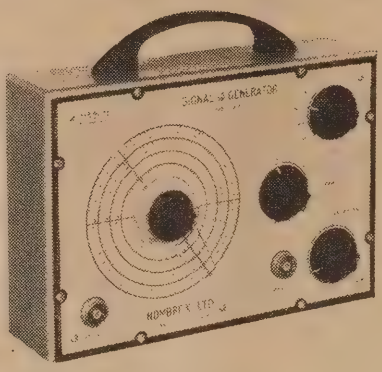

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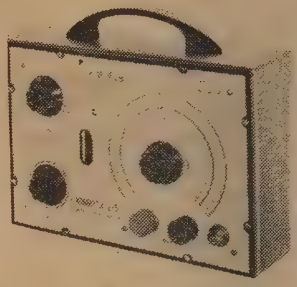

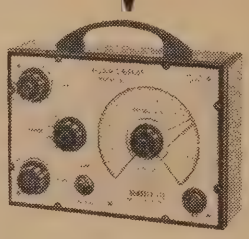

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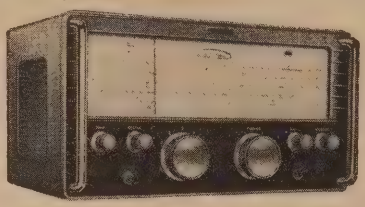

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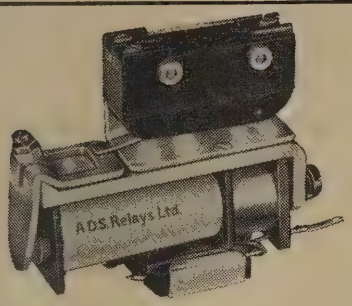
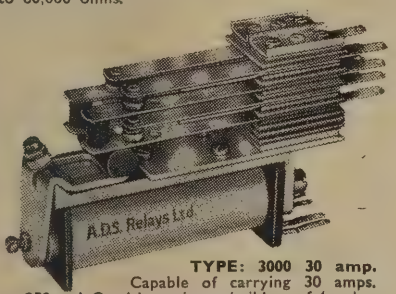
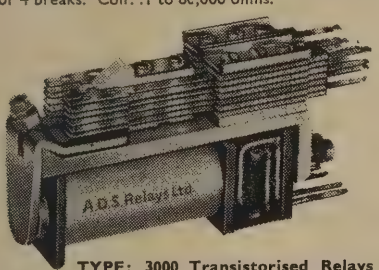
3000 TYPE RELAYS



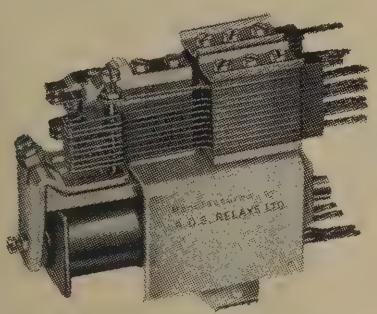
TYPE: 3000 MICRO SWITCH
Can be fitted with any type of micro switch; light and heavy duty contact sets as required. Coil: 2 to 80,000 ohms.



TYPE: 3000 30 amp.
Capable of carrying 30 amps. at 250 v. A.C. with maximum build up of 4 makes or 4 breaks. Coil: .1 to 80,000 ohms.



TYPE: 3000 Transistorised Relays
T.1 Operates from 300 to 500 micro/amps. at 1½ volts D.C.
T.2 Operates from 3 to 5 micro/amps. at 1½ volts D.C. Maximum contacts 2 change overs light duty or 2 change overs heavy duty.
T.3 Operates from 15 to 30 micro/amps. at 1½ volts D.C. Maximum contacts six change overs light duty.
T.1, T.2, T.3. Energised 12 to 18 volts D.C.



TYPE: 3000 B.O.3.
With its own bracket for fitting in any position, so designed to interlock with each other. Coil .1 to 80,000 ohms.

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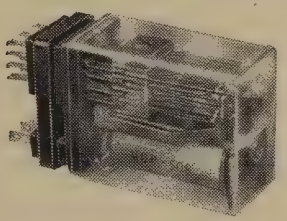
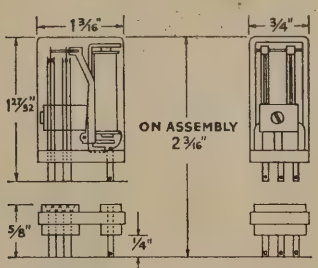
MINIATURE PLUG-IN RELAYS





Operate D.C. Volts		Type
6 Volts	68.5 mA.	(MQP 108)
12 Volts	37.0 mA.	(MQP 208)
24 Volts	19.5 mA.	(MQP 308)
48 Volts	10.2 mA.	(MQP 408)
100 Volts	4.9 mA.	(MQP 508)

Fitted 4 C at 1 amp.—
100 V.D.C.
Operate Time 6 m/S.
Release Time 4 m/S.
Insulation up to 250 V.A.C.
Twin Contacts.
Temperature: — 10° c to + 40°c.
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Fitting supplied with Relay.
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These Racks can be cut to any size.
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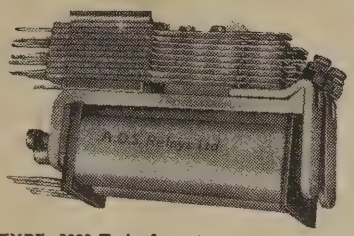
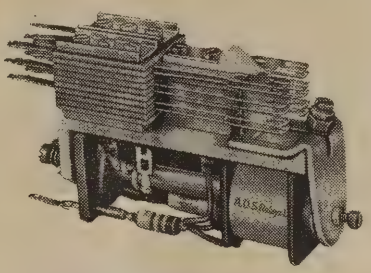
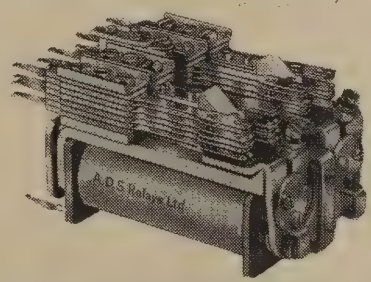


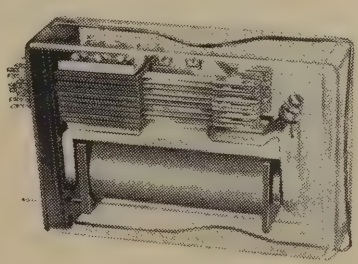
TYPE: 3000 Twin-Armature
This relay is a space saver! Two relays in one. Two coils, two armatures, working independently. Contacts maximum 4 change overs light duty or 2 change overs heavy duty. Coils: Maximum 10,000 ohms.



TYPE: 3000 Delay Relay
This relay can be supplied with operate/delay up to 25 seconds from supply of 6 to 50 volts D.C. Release delay up to 25 seconds with trigger circuits to 1½ volts D.C. Energised from 6 to 50 volts D.C. Contacts maximum 6 change overs light duty.
With adjustable resistor giving plus or minus 2 seconds of nominal figure on operate and release relays.



TYPE: 3000 Mechanical Latching Relays
Built to customer's requirements.
Coils: .1 to 80,000 ohms.



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Plug-in Relay

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Telephone: CLErkenwell 3393/4/5

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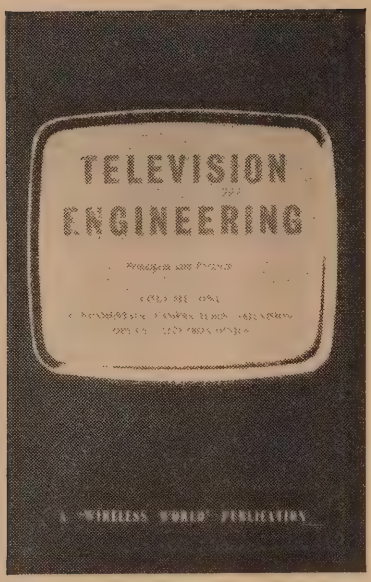

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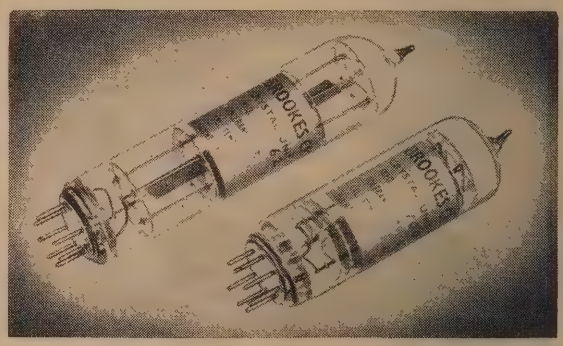

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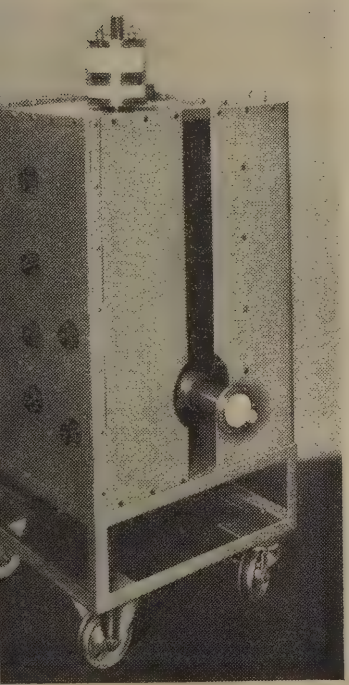
UHF POWER

25 kW KLYSTRONS

for bands IV and V television



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These klystrons are mechanically tuned multi-cavity types having output powers of 25kW at minimum gains of 30db. They are available with a full range of accessories including electromagnet frames and coils, external tuning cavities and adjustable load couplers.

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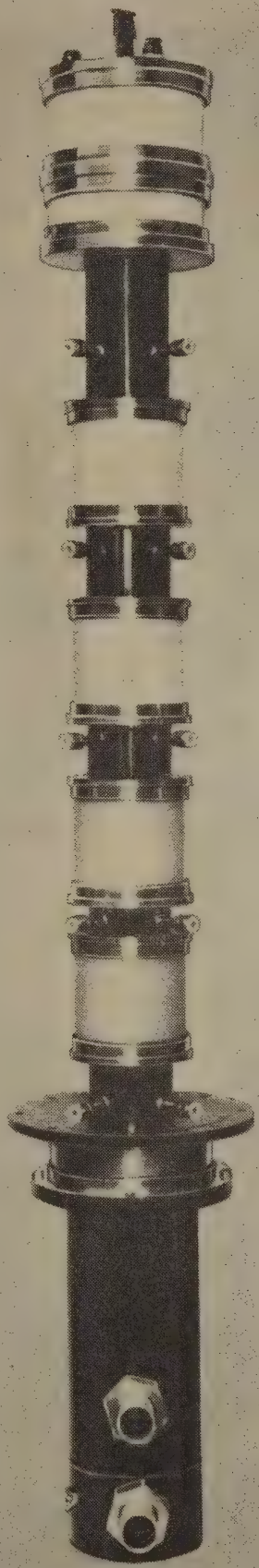
K377 klystron in circuit assembly K4055.



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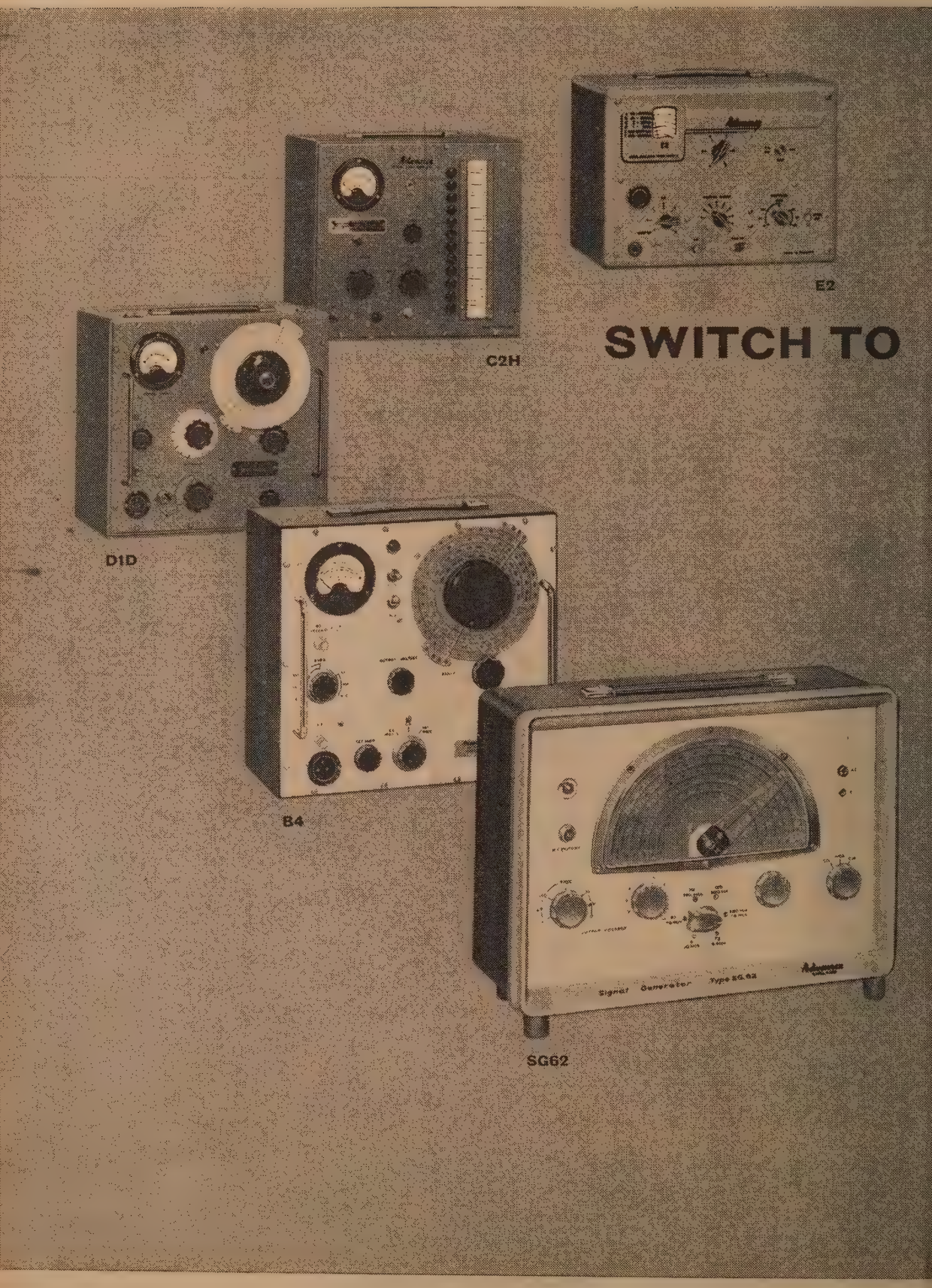
ENGLISH ELECTRIC VALVE COMPANY LIMITED

AGENTS THROUGHOUT THE WORLD | *Chelmsford, England. Telephone, Chelmsford 3491*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B4
SG62

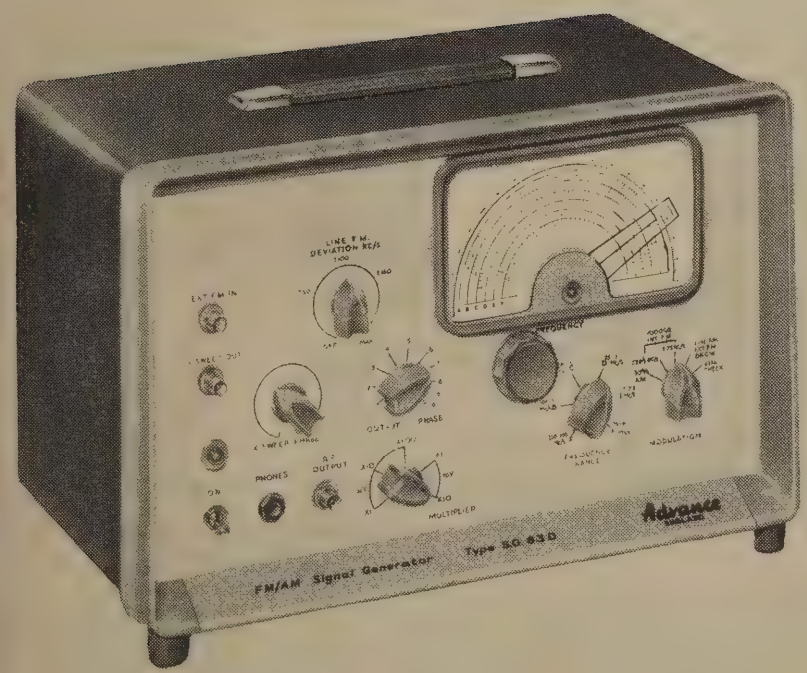
The range of Advance R.F. Signal Generators covers frequencies of 30kc/s to 300Mc/s with an accuracy of ±1%. Controls and indicators are designed to provide positive operation with ease of reading. A telephone call or letter will bring full details and specifications.

Advance

SIGNAL GENERATORS

SG63D

This Signal Generator provides frequency or amplitude modulated signals over a continuously variable range from 4 to 230Mc/s in six ranges. It has a tuning accuracy of ±1% and an internal oscillator provides calibration checks at 5Mc/s intervals to an accuracy of 0.03%. F.M. deviation variable 0 to ±200kc/s at supply frequency or fixed deviations ±22.5kc/s and ±75kc/s at 1000c/s.
PRICE NETT IN U.K. £108.0.0.



SG63D

SG62

This model covers all sound, radio and television bands with an extremely wide frequency range of 150kc/s to 220Mc/s. The scale is 50 in. long and a band-spreading device gives an open scale at the higher frequency ends of the bands. The output may be amplitude modulated at 30% at 400c/s.
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B4

This R.F. Signal Generator is available in two versions–Model A covering from 100kc/s to 80Mc/s, and Model B covering from 30kc/s to 30Mc/s. R.F. output is continuously variable between 1μV and 100mV. A crystal voltmeter monitors the R.F. output level and modulation depth which is adjustable from 0 to 80% at 400c/s or from an external frequency source.
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D1D

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E2

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RADFORD

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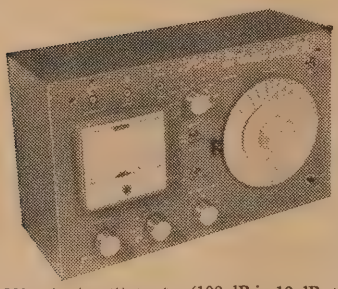
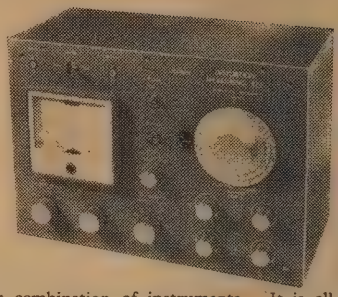


LOW DISTORTION OSCILLATOR

Basically an instrument of high stability, providing very pure sine waves directly without the use of filters in the range 5 c/s to 500 Kc/s.
The instrument is valve operated for sine wave generation, but semiconductors are used in a sine/square network to provide clean square waves from 5 c/s to 500 Kc/s. An accurate step attenuator (100 dB in 10 dB steps) is incorporated together with a 0-10 dB continuously variable attenuator which may be directly monitored on the built-in valve millivoltmeter. The millivoltmeter is a 4 stage feedback type with a very linear volt scale. It may be used for external measurement with a full scale deflection of 100 mV to 300 V (8 ranges) with better than 0.5 dB accuracy over the range of the oscillator. The inherent distortion of the sine generator is lower than that of any other known instrument.

SPECIFICATION
Mains input: 110-140 v., 210-250 v., 50/60 c/s.
Output: 5 volts max. into 600 ohms.
Frequency range: Sine waves and square waves 5 c/s-500 Kc/s.
Sine wave distortion: 0.006%, 200 c/s-20 Kc/s; increasing to 0.015% at 10 c/s and 100 Kc/s.
Specification of included valve-millivoltmeter
Input resistance: 1 Meghom.
Sensitivity: 100 mV-300 V f.s.d. (8 ranges).
Response: ±0.25 dB, 5 c/s-1 Mc/s.
Price: £95.



DISTORTION MEASURING SET

An instrument capable of measuring total harmonic distortion speedily, accurately, and directly on a calibrated meter scale without calculations or the use of ancillary balancing or rejection circuits. It is capable of reading a lower distortion level than any other known instrument or combination of instruments. It is all semiconductor operated, and is energised from an included 9 v. battery.

SPECIFICATION
Frequency range: 20 c/s-20 Kc/s (6 ranges).
Distortion range: 0.01%-100% f.s.d. (9 ranges).
Sensitivity: 100 mV-100 V (0.01% and 0.03% f.s.d. ranges operate above 1 volt inputs).
Meter: Square law r.m.s. reading.
Input resistance: 200K ohms.
High pass filter: 3 dB down at 500 c/s; 30 dB down at 50 c/s.
Harmonic response: ±1 dB 2nd harmonic to 250 Kc/s.
Price: £75.

RADFORD ELECTRONICS LTD. Ashton Vale Estate · Bristol, 3, England. *Tel:* 662301-2.

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smoothed AC-DC
POWER SUPPLIES

INPUT. 200-250 volts 40-60 c/s. or 110-120 volts 40-60 c/s. **OUTPUT.** 12 v. 24 v., other voltages from (6 v. to 250 v. D.C. to order). **RATINGS.** Up to 24 Amps. (100 Amps to order). **TOTAL RIPPLE.** Less than 1% p. to p. **REGULATION.** 5%. **OUTPUT IMPEDANCE.** .4 ohm. At 100 c/s. **EFFECTIVE RESIST.** Less than .1ohm.

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PRICE. From £14. 2. 0d.
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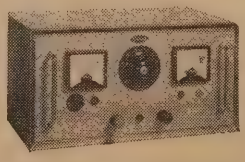

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LIMITED

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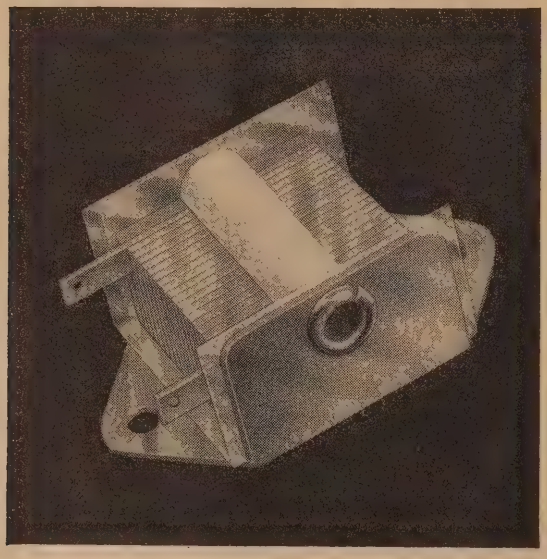

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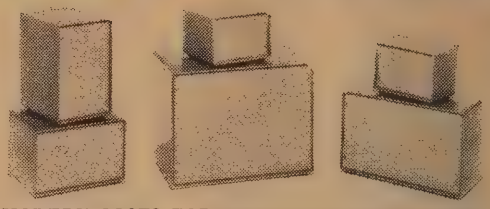

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25B	6½in.	4½in.	6½in.	18 swg
26A	8½in.	5½in.	6½in.	18 swg
26B	8½in.	5½in.	8½in.	18 swg
27A	12½in.	7½in.	5½in.	16 swg
27B	12½in.	7½in.	8in.	16 swg
28A	14in.	10½in.	6½in.	16 swg
28B	14in.	10½in.	8½in.	16 swg

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TYPE	WIDTH	HEIGHT	DEPTH	
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29B	10in.	4in.	8in.	18 swg
30A	12in.	5in.	6in.	18 swg
30B	12in.	5in.	8in.	18 swg
31A	14in.	6in.	6in.	18 swg
31B	14in.	6in.	8in.	18 swg

STANDING CASES

40A	4½in.	6½in.	6in.	18 swg
40B	5½in.	8½in.	6in.	18 swg
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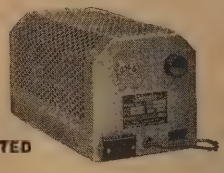

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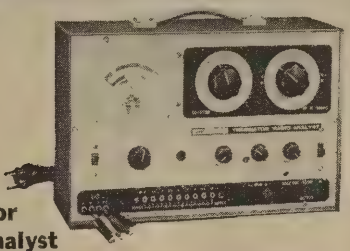
The new #1076 gives you a convenient TV signal-generating source of your own—with all signals instantly available on the television under repair. Now you can visually trouble-shoot and signal trace both black and white and color circuits! Model 1076 has easy, direct, point-to-point signal injection, permitting fast correction, anywhere, anytime. Operates 115/230 V—50-60 cycles.



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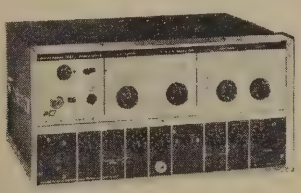
With this remarkable instrument, you can check all circuits and pinpoint any trouble in minutes. Makes transistor radio servicing quick and easy—far more profitable. The 960 makes it easy to trouble-shoot any stage by unique point-to-point signal injection. Built-in metered power supply provides quick and easy testing at any time. 115/230 V—50-60 cycles AC.



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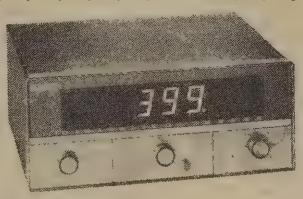
A fabulous new addition to the famous B & K series of Television Analysts.

The 1074 is a compact version of the superb 1076 and offers a complete TV signal generating source of your own. Using the B & K point-to-point signal injection technique, you can isolate and pinpoint any performance problem for quick correction. The 1074 can double your effective manpower. Operates on 115/230 volts, 50-60 cycles AC.



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With specialized experience in the test instrument field, DYNASCAN breaks through the high cost barrier and presents a reliable solid state Digital Voltmeter. Model 111 DVM provides laboratory-standard-type accuracy or better, with easy readout—minimizes operation errors. Unusual flexibility enables you to take full advantage of its time-saving, cost-saving convenience. 115/230 volts, 50-60 cycles.

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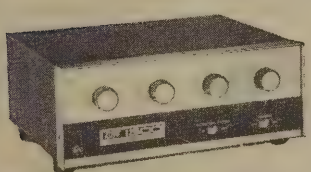

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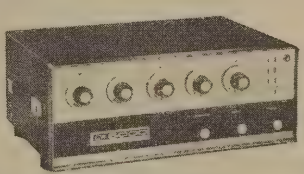

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Total flux 60,000 maxwells
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Bass resonance 50/60 c/s.
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Impedance 10/15 ohms
Flux density 16,000 oersteds
Max. input 10 watts rms or 20 watts peak
Frequency range 30-20,000 c/s.
Aluminium voice coil
Roll surround and double diaphragm
Bass resonance 38/43 c/s.
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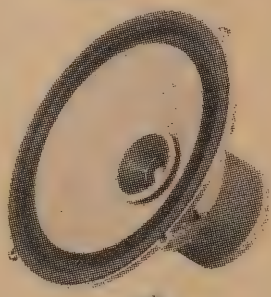

SUPER 12/RS/DD

Impedance 12/15 ohms
Flux density 17,000 oersteds
Total flux 190,000 maxwells
Aluminium voice coil
Max. input 20 watts rms or 40 watts peak
Frequency range 25-20,000 c/s.
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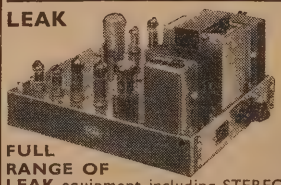

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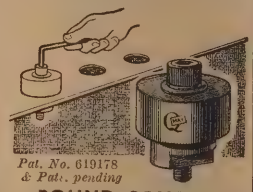

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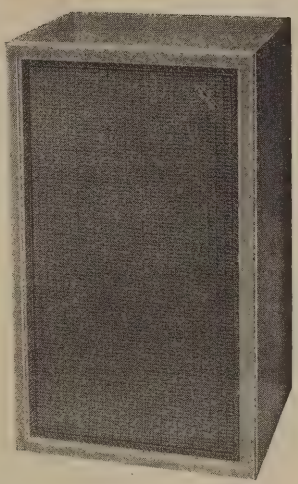
WHARFEDALE

W2



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SIZE: 23½″ × 14″ × 12″
WEIGHT: 37 lb. complete
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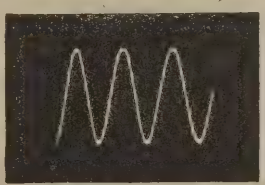
IMPEDANCE: 15 ohms



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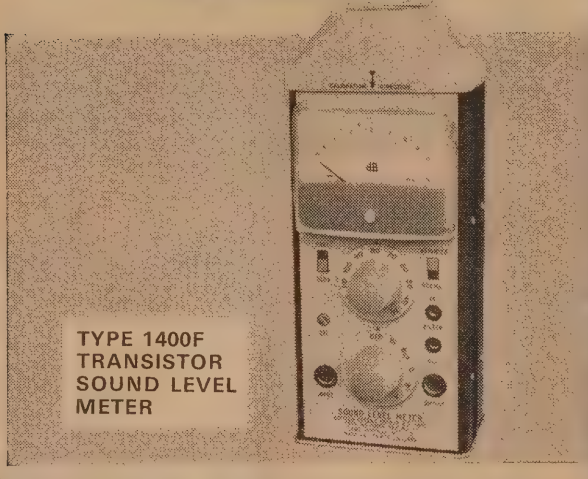

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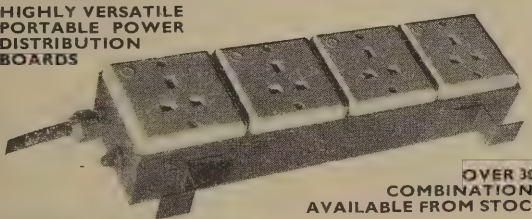

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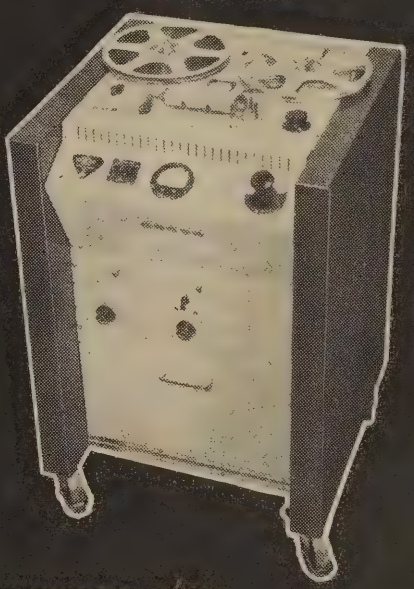

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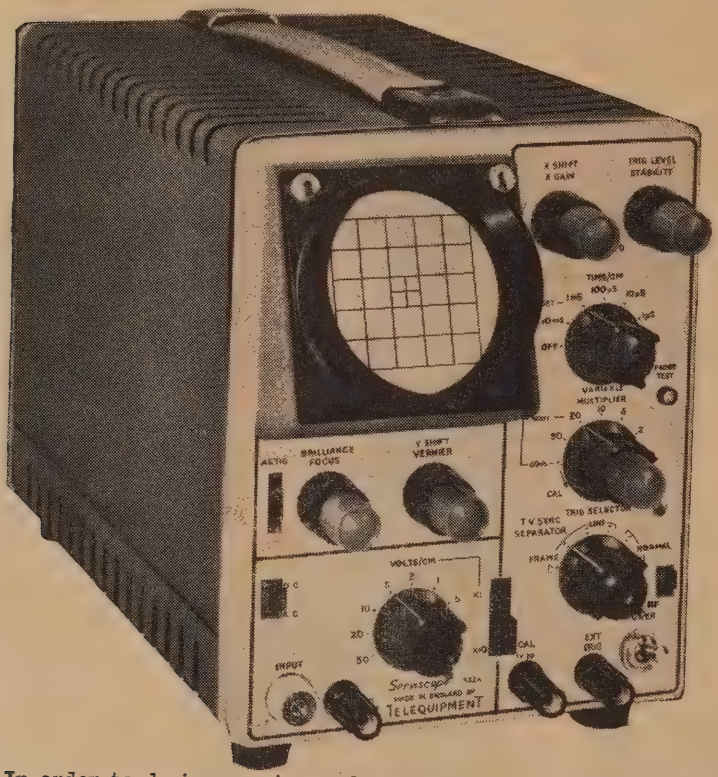

In order to derive maximum benefit from the latest wide band version of the S32A Serviscope* an H.F. Synchronisation facility has been added to the triggering arrangements. Otherwise the specification of the S32A remains unchanged. The following is a brief summary. (A leaflet giving full details will be supplied on request).

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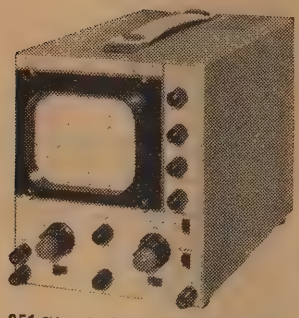

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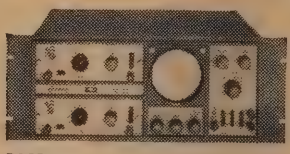
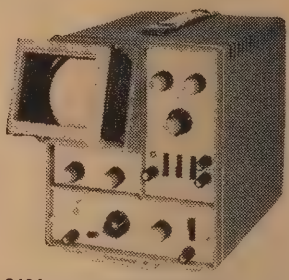


D33R Rack mounted double-beam oscilloscope with interchangeable Y amplifiers. £125 with general purpose amplifier.



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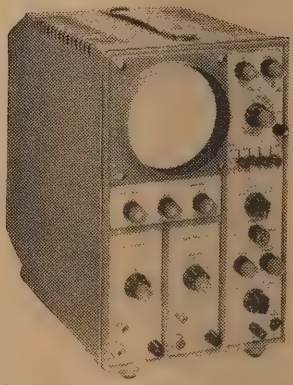

D55A Double-beam oscilloscope with trigger delay, for advanced laboratory applications and computer industry. £275.

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Wireless World

ELECTRONICS, RADIO, TELEVISION

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VOLUME 70 No. 1
PRICE: 2s 6d.

FIFTY-THIRD YEAR
OF PUBLICATION

Managing Director: W. E. Miller, M.A., M.Brit. I.R.E.
Iliffe Electrical Publications Ltd., Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager or Publisher as appropriate

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PUBLISHED MONTHLY (4th Monday of preceeding month). *Telephone:* Waterloo 3333 (70 lines) *Telegrams:* "Ethaworld, London Telex." *Cables:* "Ethaworld, London, S.E.1." *Annual Subscriptions: Home* £2 0s. 0d. *Overseas* £2 5s. 0d. *Canada and U.S.A.* $6.50. Second-class mail privileges authorised at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260 Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: U.S.A.: 111, Broadway, 6. *Telephone:* Digby 9-1197.

MULLARD ELECTROLYTIC CAPACITORS

PCF802
TRIODE PENTODE FOR LINE OSCILLATORS

LINE oscillator circuits incorporating the Mullard PCF802 are being used in the dual-standard receivers that are now appearing in readiness for BBC-2.

Because negative vision modulation will be used in the new 625-line service instead of the positive modulation of the present 405-line service, line oscillators operating on the flywheel principle are attractive. The Mullard PCF802 has been designed for use as a sine-wave oscillator whose frequency is controlled by the triode section of the valve functioning as a reactance valve.

A notable feature of this type of circuit is that only one switch is needed to change the frequency of the oscillator from that required for the 405-line standard — 10·125kc/s — to that required for the 625-line standard 15·625 kc/s.

WHAT'S NEW IN THE NEW SETS

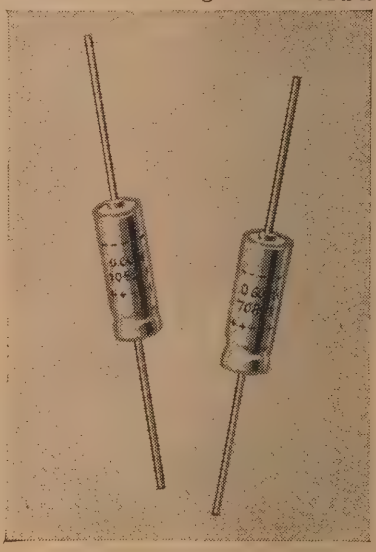
These articles describe the latest Mullard developments for entertainment equipment

Special attention has been paid in development of the new valve to minimising hum and microphonic interference. Furthermore, the amplification factor of the triode section of the valve is high, thus making the section particularly suitable for operation as a reactance valve.

Standard Series provides economy and reliability

STANDARD electrolytic capacitors of the Mullard C425 series form a notable supplement to the established C426 series of miniature electrolytics, and are frequently encountered in domestic entertainment equipment.

Although the imagination can be fired by descriptions of miniature equipment and components, space in present-day domestic equipment is not always at a premium. Reduction in cost without loss of performance is sometimes a more important factor. In applications where the smallness of can sizes 1 and 2 of the C426 series is not required, use of the standard C425 range will afford a more economical solution.



The standard capacitors are 18·7mm long and have a diameter of 6·8mm. Eleven different combinations of capacitance and working voltage are available in the series, ranging from 0·64μF, 64V to 40μF, 4V. As with the C426 series, the tolerances on these capacitances are −10, +50%, and the power factor of the components is extremely low, indicating the high quality of the capacitors.

With the lower values of capacitance in the standard series, it may be necessary to choose a voltage rating higher than that dictated by circuit conditions, but this will simply add to the long service life that is a characteristic of Mullard electrolytic capacitors.

CAR RADIO TRANSISTOR PACKAGE

The Mullard LCR2 car radio audio package comprises the OC82DM miniature driver transistor and the AD140 output transistor. The AD140 has a high current gain and possesses good linearity and frequency characteristics.

The package forms a two-stage class A amplifier capable of delivering 3W when driven directly from the detector of an all-transistor receiver. The sensitivity of the amplifier with respect to a 1kΩ source is typically 25mV for full output. The LCR2 is thus meeting the need for high audio gain in car radios, ensuring an excellent standard of performance while offering an economic design. (Replacements for maintenance should be ordered by the individual type number.)

MVE 1566

Wireless World

VOL 70 NO 1 JANUARY 1964

Hi Fi by Numbers

LETTERS from Mr. C. C. V. Hodgson and from the B.B.C. in this month's correspondence columns revive a topic which has been and probably always will be a source of controversy as long as there is interest in high-quality sound reproduction.

No one denies that the ideal sound reproducing system should have a frequency response extending to the upper limit of audibility of the youngest listener; otherwise the occasional but nevertheless important transients in sound will show differences from the original. An illustrated lecture, for instance, on the influence of the country of origin on the tonal quality of triangles would be pointless without frequencies up to or beyond 15 kc/s.

Which brings us to our point, that there is a wealth of material, including the bulk of European music which can be transmitted without detriment to the composers' intentions and enjoyed even when nothing is transmitted above 8 kc/s. In the days of 78 r.p.m. shellac records the preferred cut-off was 5 to 6 kc/s. It should not be forgotten that, as Eckersley used to say, the wider you open the window the more the dirt blows in.

Frequency response is easy to specify and to measure, but it is not the only, or indeed the first criterion of good sound quality. There are many other qualities which can be treated objectively and given numbers, but we should not forget that a performance can be spoilt also by control engineers —even musicians—who sometimes have an "off" day. Frequency response or the lack of it is usually the last thing to be appreciated by the mind in selecting meaningful clues from the complex stimulus of music.

For every listener who finds the v.h.f./f.m. transmissions of the B.B.C. deficient in high-frequency response there must be thousands who are thankful that sufficient funds were made available to provide a refuge from the pandemonium of medium waves and thus to restore the possibility of once again listening to plays and good music. This was the first objective of the v.h.f./f.m. service, not the extension of frequency range. Nevertheless, the quality is transparently good (given adequate receivers, amplifiers and loudspeakers) and interposes no serious impediment to the enjoyment of the programmes. Occasionally a programme of outstanding excellence is transmitted just as there are outstanding recordings to be found in the outputs from the gramophone companies. We think it unlikely that anyone will find any correlation here with frequency response or conversely any failure that can be attributed to lack of it. Memorable experiences in sound reproduction and recording can seldom be devised, they just happen; and when they do we accept them gratefully. They are no less acceptable because the reasons ascribed for success may prove to be false. In this connection we remember the jubilation of the wideband boys at the startling improvement in sound quality which accompanied the B.B.C.'s move to Alexandra Palace and the opening of the television service in the v.h.f. bands in 1936. This was at first widely attributed to the release from the frequency constraints of medium-wave broadcasting, but was subsequently shown to be due to the simultaneous first use of a new design of microphone "A" amplifier with less than 1% harmonic distortion.

This is not to say that Mr. Hodgson is wrong in wanting a wider audio response; we would all like to run 120 m.p.h. motor cars—just in case our journeyings might one day take us to the M1.

Elements of Transistor Pulse Circuits

1.—THE PULSE CIRCUIT FAMILY

By T. D. TOWERS,* M.B.E.

IN the last two decades, many new electronic fields have opened up where the elementary circuits or "building blocks" have tended to become more and more sophisticated. In the fields of computers, control systems, data processing, instrumentation, nucleonics, radar and telemetry, etc., although the small-signal linear amplifier is still a fundamental, the engineer is now expected to have an armoury of other circuits ready to hand—particularly non-linear, large-signal pulse circuits.

This work is aimed at providing the busy engineer with a practical review of the more commonly used non-linear building blocks in their transistor versions. The treatment is mainly practical and descriptive with a minimum of detailed analysis and mathematics.

The pulse circuit family is now so numerous that it is well to begin with a review survey, to have a look, so to speak, at the family group photograph to identify the main features of the various members, before going on to a detailed consideration of each individually. This brief review of the principa basic pulse circuits is given below.

Phase Inverter: Transistor circuitry is by now so well established that most people will have no difficulty in recognizing the common-emitter transistor amplifier appearing in Fig. 1. In the small-signal circuits of communications practice, its most important feature is the signal-voltage amplification from input to output. The phase change across the stage is of secondary importance. This type of amplifier also appears widely in pulse circuits, but in this field the fact that the output is 180° out of phase with the input is much more important. So much is this so that the circuit is often known as a "phase inverter" or simply an "inverter." It is frequently used merely to invert the polarity of a pulse without amplification.

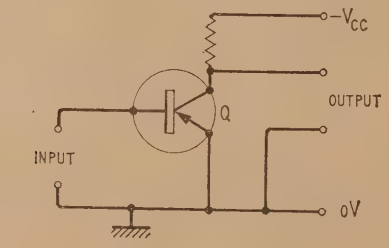


Fig. 1. Phase inverter.

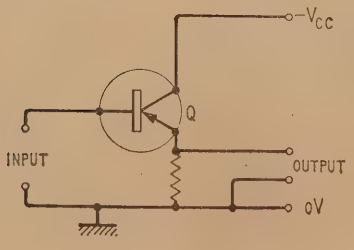


Fig. 2. Emitter follower.

Emitter Follower: The other common basic amplifier in pulse circuitry is the common-collector one shown in Fig. 2, which is usually referred to as an "emitter follower." It is, of course, the transistor equivalent of the valve cathode follower. Its principal characteristics are that the output is in phase with the input, the output voltage at the emitter always lies within a fraction of a volt of the voltage at the base (hence "emitter follower"), the input impedance is high, and the output impedance is low.

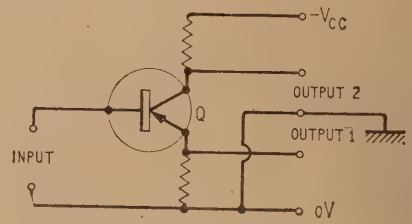


Fig. 3. Phase splitter.

Many electronic instruments take advantage of the good stability and linearity of the emitter follower. It is usually employed where there is a requirement for a high input impedance, a low output impedance or both. The input stage of a transistor oscilloscope or electronic voltmeter is usually an emitter follower. The effect of shunt capacitance in long signal leads or screened cables can be minimized by feeding from the low output impedance of such a circuit. Where one circuit feeds into another and the reaction of the second circuit on the first is to be kept low, use can be made of an emitter follower as a buffer between the two stages. The low output resistance of the emitter follower presents a barrier to feedback from the higher input resistance of the second stage. A number of other basic circuits are described below which are similar to the emitter follower in that they have a resistor in the emitter circuit.

Phase Splitter: The phase splitter (often called "balanced inverter") shown in Fig. 3 provides two output signals of opposite polarity from a single input — hence the term "phase splitter." Output 1 (from the emitter) and the input are of one polarity, and output 2 (from the collector) is of opposite polarity. If the collector and emitter resistors are of

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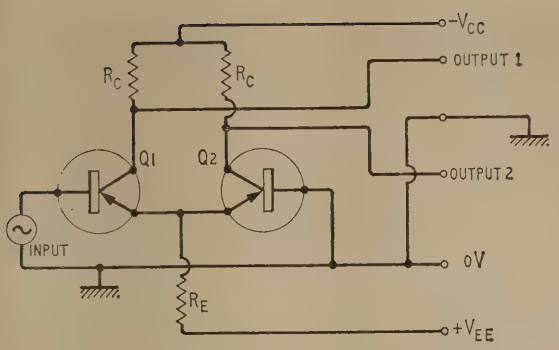

Fig. 4. Paraphase amplifier.

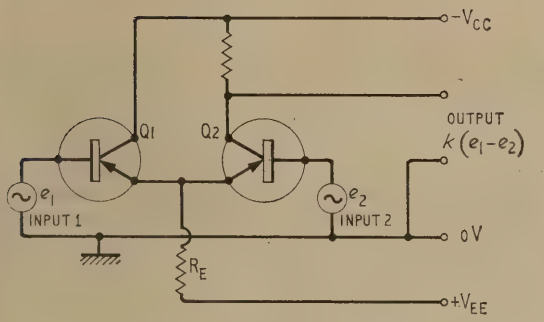

Fig. 5. Differential amplifier.

equal value, the two voltage output signals are of equal amplitude, since by transistor action the collector and emitter currents are virtually equal. The high voltage negative feedback resulting from the emitter resistor reduces the voltage gain to just below unity at both output terminals. One defect of the circuit is that while the output impedance at the collector is high (approximately equal to the collector load resistance), at the emitter it is low (approximately equal to the input source resistance divided by the transistor current gain). This impedance unbalance can be got round by including in series with the emitter output a resistance equal to the collector load resistance. The two outputs are then equal in voltage, opposite in phase and from equal source impedances. They are thus completely balanced, but the circuit has no voltage gain. A typical use of this sort of circuit is to convert a single-ended sweep voltage into a symmetrical deflection for an oscilloscope.

Paraphase Amplifier: Fig. 4 illustrates a circuit, the paraphase amplifier, which serves the same function as a phase splitter, but also provides equal signals and, without padding, equal impedances at the two outputs. This is one of the family branch known as " long-tail pairs " or " long-tailed pairs ", which all have the same feature of an emitter resistor common to two independent transistor amplifiers through which the amplifiers react on one another. The appearance of the circuit in Fig. 4 with the common emitter resistor, R_E, projecting downwards makes the term " long-tail pair " self evident. The emitters of Q1 and Q2 are close to earth potential through their forward-biased emitter-base diodes. If R_E is large, then a relatively constant direct current flows through it. If the signal voltage applied to Q1 increases, the input base current also increases. This in turn causes the emitter current of Q1 to increase. As the sum of the emitter currents of Q1 and Q2 is fixed (being equal to the total current through R_E), the current through Q2 must decrease by an amount equal to the increase in the Q1 current. These changes of current are reflected in the collector output voltages. Output 1 falls as output 2 rises. Thus for a single-ended input into the paraphase amplifier, there are available at the outputs balanced push-pull voltages from equal impedance sources (the collector resistances R_C). The circuit also provides some voltage gain from input to output.

Differential Amplifier: The paraphase amplifier described above has only one input signal. It is also possible to use this basic long-tail pair to accept two signal inputs and give an output proportional to the difference between the input signals. This is the differential or difference amplifier. The basic circuit is set out in Fig. 5. Here the two input signals are applied to the transistor bases. The voltage at the emitter of Q1 (and thus of Q2) follows the voltage at the base of Q1, so that the base-to-emitter voltage of Q2 is equal to $e_2 - e_1$. The corresponding signal voltage at the collector of Q2 is then by transistor action in Q2 proportional to this input voltage difference. When e_1 and e_2 are equal in amplitude

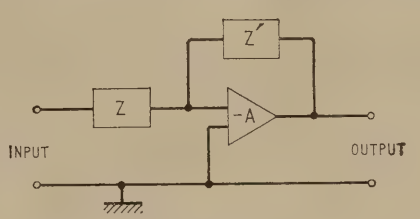

Fig. 6. Basic operational amplifier.

but opposite in polarity, i.e. when $e_2 = -e_1 = e$, then the output of the difference amplifier, being proportional to $e_2 - e_1 = 2e$, is a single sided signal proportional to the balanced input signal. This circuit can thus be used to convert the push-pull output of a phase-splitter or a paraphase amplifier to a single-sided output with respect to earth.

In the above description, signals have been shown as a.c., but they can equally well be d.c., because all have been illustrated with d.c. coupling.

Operational Amplifier: Another class of amplifiers widely used in non-linear circuits is the " operational amplifier " shown in block form in Fig. 6. The internal amplifier gain A is real and negative, i.e. it has 180° phase shift and greater than unity amplification from input to output. The external voltage feedback loop across the amplifier through the impedance Z′ combined with the series input impedance Z gives the complete operational amplifier certain useful properties. For example, where the internal amplifier gain is very large, it can be shown that the operational amplifier gain is approximately Z'/Z. The description " operational " arises because this type of amplifier may be used to accomplish a number of mathematical operations.

With transistors, the basic operational amplifier

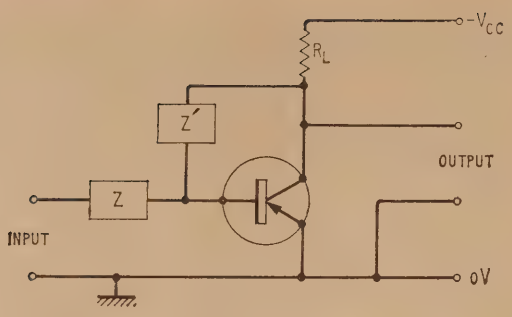

Fig. 7. Transistor operational amplifier.

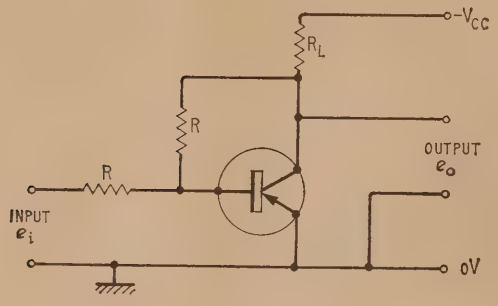

Fig. 8. Sign changer.

takes the form of Fig. 7, where a common-emitter configuration provides the necessary real negative voltage gain.

Sign Changer: To change the sign of a signal (i.e. phase change 180° without amplitude change), Z′ is made equal to Z. For d.c signals this would take the basic form shown in Fig. 8 where the feedback impedances Z and Z′ are equal resistances R.

For a.c. signals, however, the two resistors R could be complex impedances, i.e. any combination of R, L and C, although usually, for simple sign change, resistors alone are used to ensure a phase shift independent of frequency.

Scale Changer: To change the scale of a signal (i.e. amplitude change by a factor k), the feedback components of the operational amplifier should be selected to have $Z'/Z = k$, a real constant. Again, scale change is usually effected with Z and Z′ selected as resistors, which gives the circuit of Fig. 9. In this, the output voltage is of opposite sign to the input, and increased by a factor k. Often the analogy is drawn here between the scale-changer operational amplifier and a lever with its fulcrum at the transistor base. The output volts go down as the input volts go up and the output volts travel is k times that at the input.

Phase Shifter: To change only the phase of a sinusoidal a.c. signal, the series and feedback impedance components of the basic operational amplifier of Fig. 7 should be made equal in magnitude but should differ in phase angle. By using suitable values of capacitance or inductance, by themselves or with resistors, any phase shift from 0° to 360° may be obtained at any selected frequency.

Integrator: A specific example of phase shifting is the integrator circuit of Fig. 10 where the series input impedance is a resistor and the feedback impedance a capacitance. Here it can be shown that the output voltage e_o is related to the input voltage e_i by the formula

$$e_o = -\frac{1}{RC}\int e_i dt$$

The amplifier thus provides an output signal which is proportional to the time integral of the input voltage, i.e. it is an integrator.

Differentiator: Another phase-shift version of the operational amplifier is the differentiator circuit shown in Fig. 11. Here the series input impedance is a capacitor C and the feedback impedance a resistor R. It can be shown that the output voltage e_o is related to the input voltage e_i by the formula

$$e_o = -RC\, de_i/dt$$

The amplifier thus provides an output voltage which is proportional to the time derivative of the input voltage, i.e. it is a differentiating circuit or " differentiator ".

Adder: A final use of the operational amplifier is to obtain a single output voltage which is a linear combination of a number of input circuits. This is illustrated in Fig. 12, with two inputs, where the

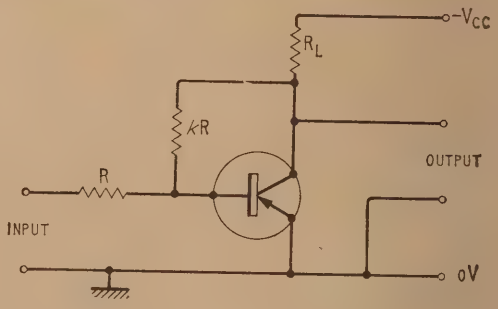

Fig. 9. Scale changer.

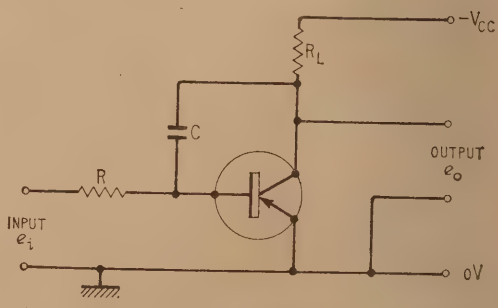

Fig. 10. Integrator.

input series impedances R_1 and R_2 and the feedback impedance R′ are all resistive. It can be shown that the output voltage e_o in this case is related to the input voltages e_{i1} and e_{i2} as follows:—

$$e_o = -\frac{R'}{R_1} e_{i1} - \frac{R'}{R_2} e_{i2}$$

Thus the output voltage is linearly related to the two input voltages.

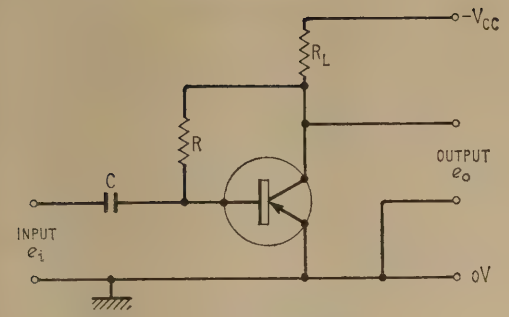

Fig. 11. Differentiator

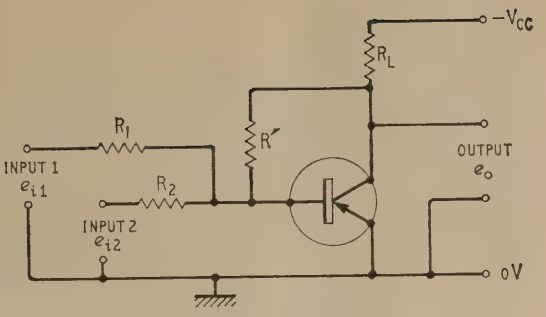

Fig. 12. Adder.

If now R_1 is made equal to R_2, the output voltage is given by

$$e_o = -\frac{R'}{R_2}(e_{i1} + e_{i2})$$

This makes the output voltage proportional to the sum of the input voltages. The circuit is then known as an "adder". The addition action has been demonstrated for two inputs only but clearly more than this could be used.

In the more general case where the input resistors have different values, by suitable selection of resistors the scale of each input can be adjusted before adding.

This is only one of the many methods of combining a number of signals but it has the advantage that it may be extended to a very large number of inputs requiring only one additional resistor for each input. With a sufficiently high gain amplifier, there is a minimum of interaction between the input sources.

Linear Sweep Generators

A common requirement in non-linear circuitry is a linear sweep generator which produces an output voltage varying linearly with time. The simplest linear sweep is obtained by suddenly applying a direct voltage, V, to a resistor R and a capacitor in series as shown in Fig. 13 and taking the voltage across the capacitor as output. The resulting voltage v_o obeys the equation $v_o = V(1-e^{-t/CR})$.

This gives a nearly linear rise in voltage so long as t is very much less than CR. Indeed it can be shown that the deviation from a linear rise $v_o = Vt/CR$ is less than 5% if t does not exceed CR/10, or if the output voltage does not rise above V/10. The rate of change of the output voltage can be shown to be given by

$$dv_o/dt = i/C$$

where i is the charging current through the resistance. The more constant i is, the better the linearity of the sweep.

One method of improving linearity is to use the constant-current collector characteristic of the transistor whose base input current is fixed. This is illustrated in Fig. 14 where the base current of the transistor Q is fixed (neglecting the small forward drop in the base emitter diode) by the base supply voltage V_{BB} and the base input series resistor R_B. When the switch S is closed, the voltage V is applied *via* the capacitor C between the collector and emitter of the transistor, which therefore conducts, the voltage polarities being correct for a p-n-p transistor as shown. As the transistor base current is fixed, so is its collector current. Thus the capacitor charging current is fixed and the output voltage rise is virtually linear. The charging current can be controlled by varying R_B and consequently the transistor collector current.

Bootstrap Circuit: A better method for linear charging of a capacitor, however, is to use a large amount of negative feedback to keep the voltage across the series charging resistor R of Fig. 13 constant. The feedback circuit for achieving a constant charging current into the capacitor is the well-known "bootstrap" circuit. The basic arrangement is shown in Fig. 15 (a). When the input switch, S, is closed to short-circuit the capacitor C, the supply battery voltage V is effectively applied between earth and the top of resistor R, and C is discharged. If now switch S is opened, any voltage applied from V *via* R to the point X at the amplifier input, would reappear at the output of amplifier A (unity gain) and be applied *via* battery V to the top end of R. Thus the direct voltage across R (and thus the current through it) would remain constant

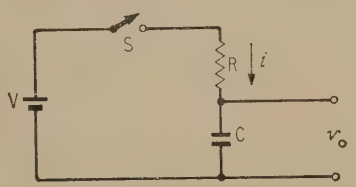

Fig. 13. Capacitor charge circuit.

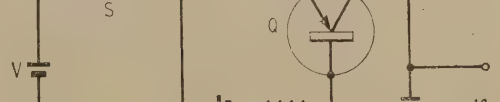

Fig. 14. Transistor linear capacitor charging.

although the voltage at X changes. Thus C charges up with a constant current and we get a linear voltage rise at the output. It should be noted that amplifier A not only should have unity gain, but must have a high input impedance so as to take negligible input current and low output impedance so as to have negligible voltage drop across the

output. The bootstrap circuit is a true integrator, whose name arises from its ability to " pull itself up by its own bootstraps ".

The basic transistor version of the bootstrap integrator is given in Fig. 15(b). Here the switch S is normally closed and capacitor C is discharged. When S is opened, transistor Q acts as a unity gain amplifier to transfer the rising voltage on C to the top end of R. The capacitance C_F is very large compared with C and the voltage across it does not vary significantly as C charges up. Thus C_F substitutes for the battery V in Fig. 15(a). The current through R is virtually constant and the voltage in C rises linearly. The emitter follower Q has the requisite unity gain, high input impedance and low output impedance. The diode D is included so that as the voltage at the top end of R is bootstrapped up, and rises above the rail voltage, it reverse-biases the diode and cuts off the timing circuit from the power supply.

Miller Integrator: Another method for improved linear charging up of a voltage across a condenser is the Miller " integrator " shown schematically in Fig. 16(a). Normally switch S is closed, and capacitor C discharged. When S is opened C begins to charge up through R, and it can be shown that due to the feedback through C, the output rate of rise is the same as would have been achieved with a capacitance $A \times C$ in series with a resistance R across a voltage supply $A \times V$, where A is the voltage amplification factor of the amplifier. This effective multiplication of the capacitance by the amplifier gain is of course the Miller effect and hence the description " Miller integrator." The apparent increase of both capacitance and rail voltage lead to a much more linear voltage rise than would have been achieved with the same values without the feedback amplifier.

A simple transistor version of the Miller integrator is given in Fig. 16(b). Here the transistor Q acts as the high gain amplifier. Normally switch S is closed and transistor Q, with base then connected

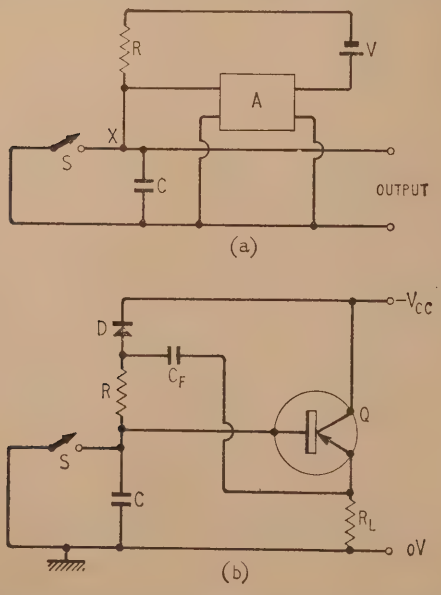

Fig. 15(a). Basic bootstrap integrator; (b). Transistor bootstrap integrator.

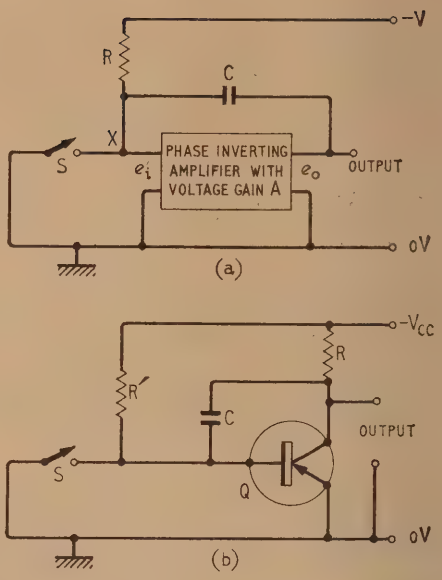

Fig. 16(a). Basic Miller integrator; (b). Transistor Miller integrator.

to earth, is cut off. With no collector current flowing, there is no voltage drop in R, the output is at rail voltage and the capacitor C is fully charged. When S is opened, base current begins to be supplied through R′ and the transistor begins to switch on. By the feedback through C as explained earlier, the voltage at the output falls linearly from the rail voltage level towards earth.

High Input-Impedance Amplifier

Darlington Pair: In pulse circuitry there is often a requirement for an amplifier with a high input resistance and a low output resistance. The emitter follower discussed earlier does provide these to some extent, but where they are required to a higher degree, use is often made of the compound emitter follower or " Darlington pair " illustrated in Fig. 17. To a first approximation, the current gain of this circuit is equal to the product of the current gains of the individual transistors. The input resistance is equal to the emitter load resistance multiplied by this current gain product and the output resistance to the source resistance divided by this product. From this it is clear that very high input and very low output resistances are possible.

Bootstrap Amplifier: Another circuit used to achieve high input resistance, especially where base-bias resistor networks are likely to shunt the signal input is the bootstrap input circuit in Fig. 18. Here negative feedback introduced by the unbypassed emitter resistor gives a high input impedance at the base of the transistor Q. To prevent this being shunted significantly by the base bias network R_1, R_2, the base bias current is supplied through an isolating resistor R_3 from the centre point of R_1 and R_2. A capacitor C connected between the transistor emitter and the bottom end of R_3 feeds back a signal voltage almost equal to the voltage at the top end of the emitter resistor R_E. It can be shown (if C is large enough for its reactance to be

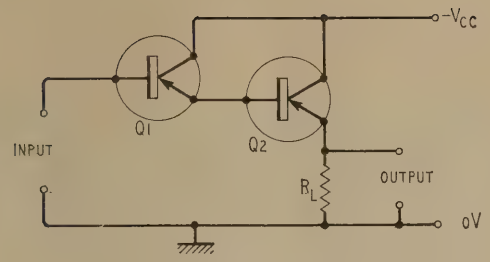

Fig. 17. Darlington pair.

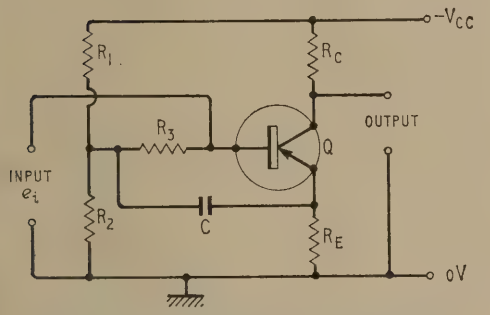

Fig. 18. Bootstrap high-impedance amplifier.

neglected at the frequency considered) that the signal voltage across R_3 is $(e_i - Ae_i)$, where A is the voltage amplification of the transistor. Thus the bias network draws from the signal source a current of only $e_1 (1-A)/R_3$. This means in effect that R_3 is effectively multiplied by $1/(1-A)$ so far as the a.c. signal current is concerned, while still representing its own value for d.c. bias purposes. With high gain transistors, A can be brought very close to unity so that $1/(1-A)$ can be very large, and the bias network does not significantly shunt the signal input. This is only one further example of " boot-

the circuit can be made to give a periodic train of pulses (astable or free running), or single pulses when triggered by a suitable pulse input.

The blocking oscillator is often used as a clock oscillator to generate a continuous train of accurately-controlled short pulses to synchronize a series of switching operations. It is also used to obtain abrupt pulses from a slowly-varying input triggering voltage, i.e., for pulse reshaping. It can be easily arranged to generate pulses of very large peak power with a low duty cycle. It also finds uses as a frequency divider, a low-impedance switch and a gating voltage source.

Multivibrators: Another regenerative two-stage circuit frequently met with is the multivibrator. In its commonest transistor form, as in Fig. 20(a) this is a two-stage common-emitter amplifier with phase inversion over each stage, and with the output heavily coupled back to the input. This heavy positive feedback gives the circuit the property of switching rapidly between two extreme states, with one transistor switched hard on and the other cut-off. How long it stays in the extreme states is decided by the cross coupling impedances Z and Z′ selected. There are three basic possibilities all derived from the general circuit shown in Fig. 20(a).

Astable Multivibrators: When both cross-coupling impedances Z, Z′ are capacitances, we get the circuit of Fig. 20(b), which is free running (astable), and produces at each collector a train of rectangular pulses, without external triggering. Hence it is often called a square wave generator.

Bi-stable Multivibrator: When both cross-coupling impedances of Fig. 20(a) are resistances we have the bi-stable multivibrator illustrated in Fig. 20(c). This can exist indefinitely in either of two stable states with one transistor on and one transistor off, but also it can be caused to make an abrupt transition from one state to the other by a suitable external trigger pulse. It finds extensive application in pulse circuitry to generate square waves from pulses, and for certain digital operations such as counting.

Monostable Multivibrator: The last member of the multivibrator branch of the pulse circuit family is the monostable multivibrator shown in Fig. 20(d). The use of a resistor and a capacitor for cross coupling in this circuit gives the curious property of one permanently stable state (Q on and Q′ off) and one quasi-stable state (Q off and Q′ on). The circuit normally lies in its stable state but if suitably triggered it passes abruptly into the quasi-stable state for a

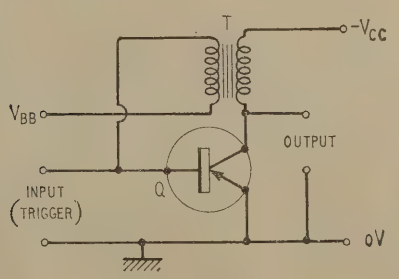

Fig. 19. Blocking Oscillator.

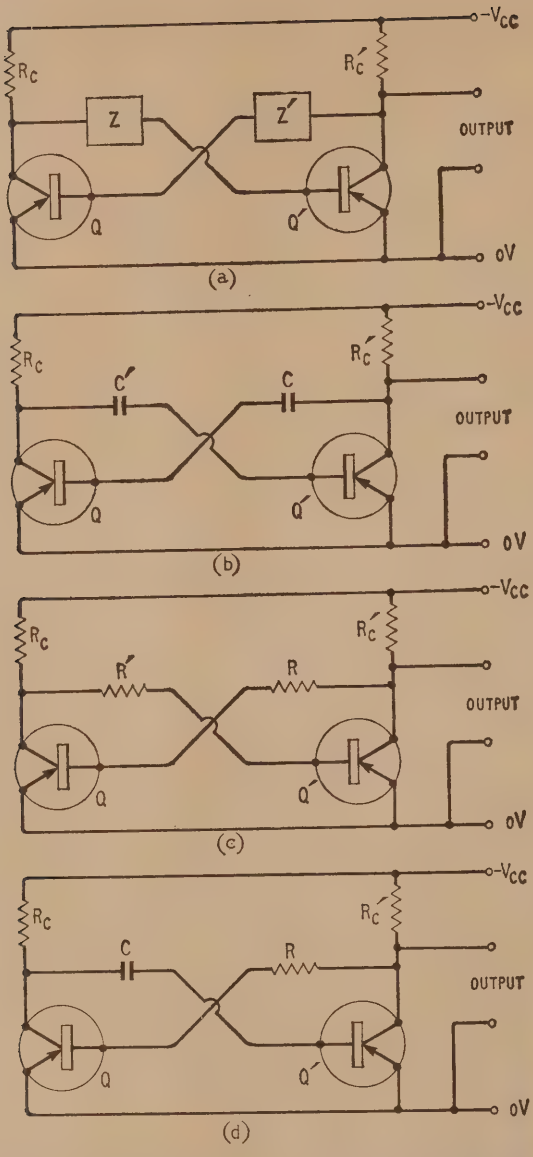

Fig. 20. (a). Basic multivibrator. (b). Astable multivibrator. (c). Bi-stable multivibrator. (d). Monostable multivibrator.

time which is long compared with the transition time between states. Eventually, however, this multivibrator will return abruptly to its stable state on its own without any external signal being required to produce the reverse transition.

The primary use for the monostable multivibrator is to establish a time interval which starts on the application of a pulse, but whose length is independent of the length of the trigger pulse. It is much used for pulse reshaping and for establishing preset delays.

Schmitt Trigger: There are many derivatives of the blocking oscillator and multivibrator circuits described above, but in this brief preliminary survey mention can be made of only one. This is the Schmitt trigger, illustrated basically in Fig. 21. It has the interesting property that when the input

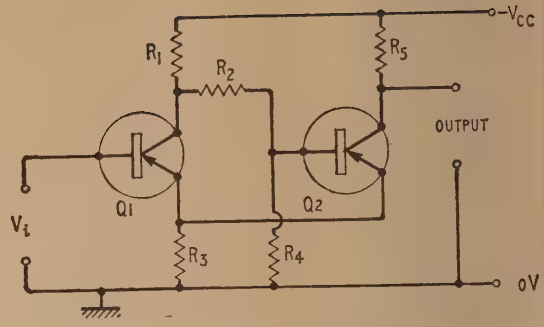

Fig. 21. Schmitt trigger.

voltage V_{in} is below a certain level, called the triggering level, the transistor Q2 is hard on and Q1 cut off. When V_{in} rises above the triggering level, there is an abrupt changeover, Q1 switching on and Q2 off. If V_{in} is reduced again below the trigger level, the circuit returns to its original state. From this it is clear that the Schmitt trigger is neither bi-stable nor monostable in the ordinary sense. It behaves like a non-regenerative switch controlled by the input d.c. level, but has the advantage that it switched abruptly at very high speed and can be designed to have an accurate adjustable trigger level. The circuit is very widely used to produce a square wave from a slowly varying input of irregular pulse shape, and as a sensitive voltage level detector.

Conclusion

This preliminary brief survey of transistor non-linear circuits is necessarily incomplete, but is designed to give the reader some idea of the variety of such circuits in common use, and how they differ from the linear small-signal circuits which are the main building blocks in the communications field. Later the properties and applications of these non-linear circuits will be dealt with in more precise detail.

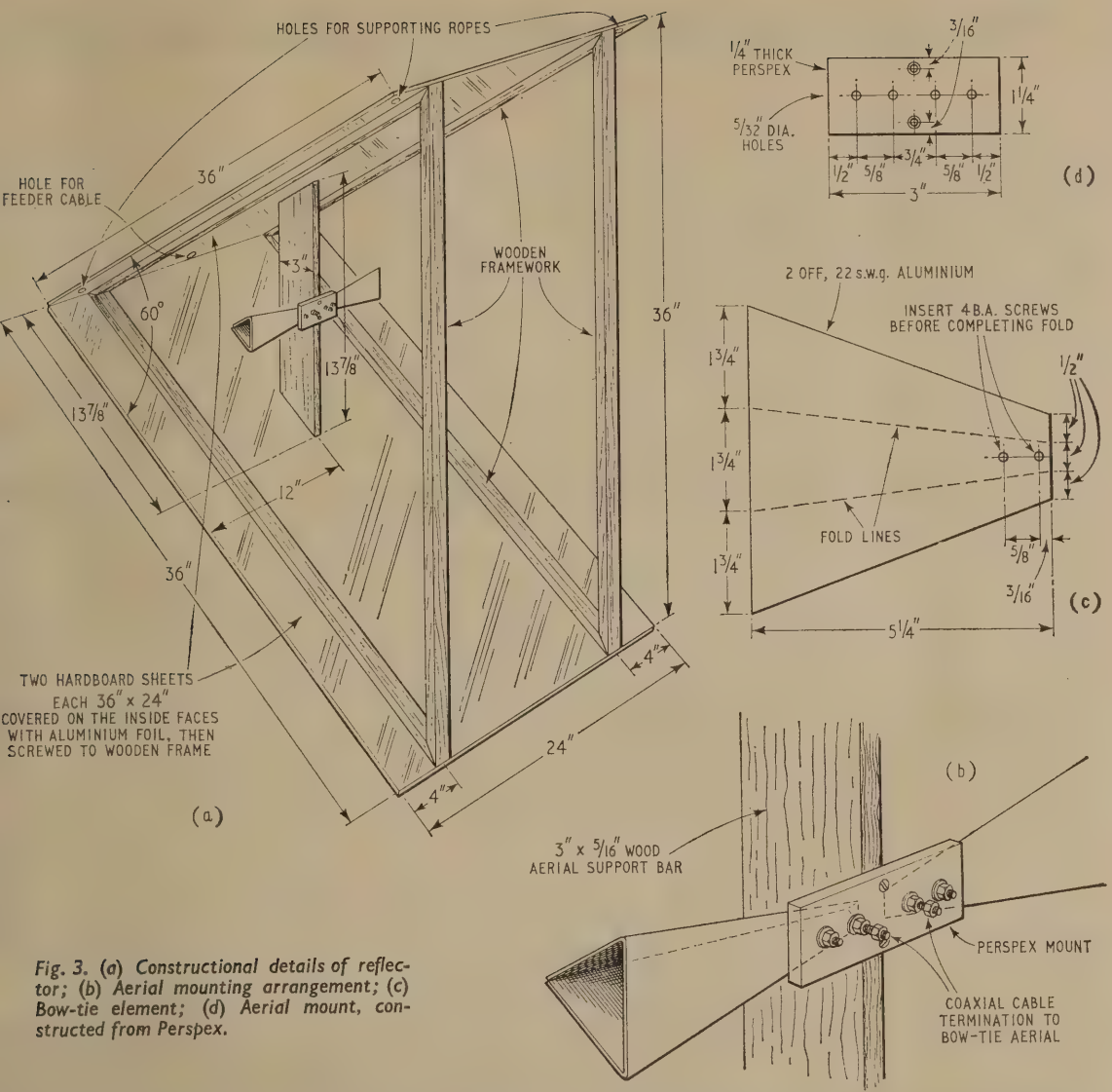

Fig. 3. (a) Constructional details of reflector; (b) Aerial mounting arrangement; (c) Bow-tie element; (d) Aerial mount, constructed from Perspex.

22 s.w.g. aluminium sheet folded into a triangular formation as shown in Fig. 3. The two halves are tapered to provide more uniform impedance transfer to the cable. A balun was not used, but could of course be incorporated at the lead-away point if required. The construction should be clear from the diagrams, but it may be necessary to unscrew temporarily the major components in order to negotiate the trap door into the loft.

To position the aerial for optimum pick-up a trial and error method could be employed, but it is definitely worth the trouble to run a long lead between the television receiver and a meter in the loft so that one can witness at first hand the effects of aerial positioning. Suitable metering points can usually be found either at the a.g.c. line, ratio detector or video drive to the tube, though in the latter case the effects of signal modulation make adjustments a little more diffcult. The picture quality should finally be checked for multiple effects, when final adjustmets should be made to the aerial position if ghosting is in evidence. In the author's case the optimum position of the aerial is about 4ft above the floor joists and the aerial has conveniently been roped to hooks screwed into the rafters. A helical membrane type of coaxial feeder was used as a down lead and a direct comparison between a commercial 13-element Yagi and the corner reflector, both optimized as regards mounting position, showed no measurable difference in signal power delivered to the receiver.

Results at the author's address, some 23 miles from Crystal Palace, are somewhat poor as a nearby hill provides a considerable diffraction loss. Hoped-for improvements in receiver noise factors, which should come from the use of u.h.f. transistors, plus the 5dB increase in transmitter power expected next year, have so far deterred the author from climbing up to the chimney stack with a commercial type Yagi, although admittedly the few extra dB may prove necessary in the long run. For readers situated mor favourably the aerial described may be worth trying; the cost is trivial and it can be constructed within a few hours.

PHYSICAL SOCIETY EXHIBITION

BRITISH manufacturers were invited by the Institute of Physics and the Physical Society to submit details of up to six exhibits for this annual exhibition. From the 744 submitted 448 have been selected by the panel of referees as "conforming to the standards of originality and scientific merit" set by the organizers. These exhibits are being displayed by 124 manufacturers and in addition 30 Government research organizations, universities, colleges, etc. are taking part. The overall number of exhibitors has increased by 20 compared with last year bringing the total to 154.

A section of one of the halls is being devoted to a selection of new equipment primarily designed for the teaching of physics.

We give in these pages a preview of the exhibition compiled from information supplied by exhibitors. Some of the companies and organizations participating were not able to give us the information asked for in time for inclusion in this preview and, of course, there are others whose exhibits do not come within the purview of *Wireless World*. While, therefore, this is not a complete survey it will, we hope, serve as a useful guide to those intending visiting the exhibition and be of general interest to those of our readers unable to visit the show. Where we have thought it might be useful we have appended a number for use on the reply card by professional readers requiring further information on specific exhibits. We hope to publish a further report in the next issue after *Wireless World* staff have visited the stands.

The exhibition, the 48th in the series, opens at the Royal Horticultural Society's Halls, Vincent Square, London, S.W.1, on January 6th for four days. It will be open from 10.0 to 6.30 each day but on the 7th admission before 1.0 is limited to members of the Institute and Society and invited guests.

Admission is by ticket obtainable from exhibitors or direct from the organizers at 47, Belgrave Square, London, S.W.1. Applicants are asked to enclose a stamped addressed envelope to accommodate the tickets ($4\frac{1}{2} \times 3$in).

A Handbook (which is a useful book of reference) is again being issued by the organizers from whom it is obtainable price 10s plus 2s postage.

This year's exhibition lectures are:—

"The electrical properties of thin films" by Prof. E. H. Rhoderick (7th at 3.0).

"Patient monitoring: technical problems and its impact on hospital administration" by H. S. Wolff (8th at 5.0).

"Instruments for noise measurement" by H. J. Purkis (9th at 3.0).

LIST OF EXHIBITORS

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A.E.I.	139
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Airmec	12
Aveley Electric	18
Avo	127
B.I.S.R.A.	17
Baldwin Industrial Controls	8
Beckman Instruments	75
Bell & Howell	131
Bellingham & Stanley	82
Birmingham University	89 & 90
Brandenburg	14
Brighton College of Tech.	102
Bristol University	81
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British Oxygen Co.	115
Bryans	105
C.N.S. Instruments	32
Cambridge Instrument Co.	149
Camlab	116
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Chemical Electronics Co.	13
Cossor Instruments	21
Coulter Electronics	37
D.S.I.R.	54
Dawe Instruments	126
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Devices	26
Digital Measurements	33
Dynatron Electronics	101
E.M.I. Electronics	15
Edwards High Vacuum	144
Ekco Electronics	100
Electrical Remote Control	93
Electron Physical Insts.	106
Electronic Applications	27
Electronic Instruments	96
Elliott-Automation	133, 134, 136 & 153
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English Electric Valve Co.	58
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Ferranti	95
Fielden Electronics	47
Fisons Fertilizers	30
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G.E.C.	142
Gallenkamp & Co.	74 & 163
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Genevac	140
George Elliott Laboratories	46
Graphic Instruments	38
Gulton Industries	117
Guy's Hospital Med. Sch.	67
Hatfield Instruments	11
Hilger & Watts	109 & 155
Imperial College	87 & 88
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Instron	20
International Res. & Dev.	60
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Lewis, H. K.	150
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Plessey	10
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Pullin	108
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Royston Instruments	48
S.E. Laboratories	25
S.T.C.	120
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Shandon	78
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Simon-Carves	86
Southern Analytical	2
Sogenique (Electronics)	51
Specto Avionics	45
Sperry	3
Sunderland Technical College	63
Techne (Cambridge)	5
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Telequipment	162
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GUIDE TO THE STANDS

A.E.I. (139)

Among the products of the company's Instrumentation Division being demonstrated is a new high-resolution electron microscope (EM6B) combining high performance with simplicity of operation. The electron optical system provides a continuous range of magnification from ×1,000 to ×250,000 and the instrument has a resolution of 5 angstroms.

The Electronic Apparatus Division will be showing a photoelectric high-speed camera tube developed to provide a means of recording events requiring time resolutions better than 10^{-1}nsec for their evaluation.

The dielectric anisotropy detector to be shown is for the detection of cracks and similar imperfections in those insulating materials which are heterogeneous and unsuitable for ultrasonic techniques. **4WW 301**

Associated Electrical Industries Ltd., 33 *Grosvenor Place, London, S.W.*1.

AMF BRITISH RESEARCH LAB. (61)

A fuel cell will be shown using an ion-exchange membrane to give what is effectively a gas-impermeable solid electrolyte. A bismuth telluride-copper junction has been found to give a very close approximation to a square law when used as a thermo-junction, and examples will be demonstrated. **4WW 302**

AMF British Research Laboratory, Blounts Court, Sonning Common, Reading, Berks.

A.W.R.E. (50)

Among the items to be shown by this establishment of the United Kingdom Atomic Energy Authority will be an electron tube developed for recording the modulation of light from a ruby laser. The design of the electron optics of the tube was carried out by Mullard under a design study contract.

A variety of pressure transducers (including piezoelectric, diaphragm and pressure gauges) developed for recording transient shock waves in gases and liquids will also be shown.

A section of the display will be devoted to high-speed photography including some systems employing electro-optic techniques.

Atomic Weapons Research Establishment, Aldermaston, Berkshire.

ADMIRALTY (9)

From the Baldock laboratory, a gas laser will be shown, consisting of a ring of reflectors and used for the measurement of small angular movements. Two frequencies are produced, the difference corresponding to angular velocity of the system. Light-emitting p-n junctions will be demonstrated. Other Admiralty establishments will also be represented.

*Research & Development Services Department, Admiralty, Empress State Building, London, S.W.*6.

AIRMEC (12)

A range of test and laboratory instruments are to be shown this year together with precision cable connectors and adaptors. Frequency standards, signal generators, wattmeters and u.h.f. slotted lines are included in the displayed range of instruments. **4WW 303**

Airmec Ltd., High Wycombe, Bucks.

AVELEY ELECTRIC (18)

Among the exhibits will be an automatic hystograph. This is an electromechanical instrument which provides a columnar display of 10 or more series of electrical impulses. The demonstration will show the operation of the hystograph in conjunction with an Aveley tolerance analyser to show the distribution of values in a batch of resistors or capacitors in the form of a hystogram. **4WW 304**

Aveley Electric Ltd., South Ockendon, Essex.

AVO (127)

A new transistor voltmeter will be presented, having an input resistance rising to 30MΩ on the higher ranges. Maximum sensitivities are 100mV and 30μA full-scale. The instrument is battery powered. A semiconductor amplifier which is to be shown is intended for the measurement of currents down to 10^{-13}A. **4WW 305**

Avo Ltd., 92-96 *Vauxhall Bridge Road, London, S.W.*1.

B.I.S.R.A. (17)

A method of measuring the oxygen content of gases has been developed, using a reversible, solid-electrolyte electrochemical cell. Gases of unknown and known oxygen contents are applied to the electrodes and the e.m.f. measured.

An inductive-loop digital data transmission system for cranes will be demonstrated in model form.

British Iron & Steel Research Association, 11 *Old Park Lane, London, W.*1.

BELL & HOWELL (131)

The Consolidated Electrodynamics division of Bell & Howell are to exhibit several types of strain gauge transducers. They are also going to show a recording oscillograph they have developed to record data, from d.c. to 10kc/s, on eighteen separate channels. **4WW 306**

Bell & Howell Ltd., Consolidated Electrodynamics Division, 14 *Commercial Road, Woking, Surrey.*

BIRMINGHAM UNIVERSITY (89 & 90)

The Department of Electrical Engineering propose to demonstrate a character recognition system, a linear saturable reactor and a method of measuring internal stresses in metals by ultrasonics. The first-mentioned exhibit consists of an information extraction unit, which utilizes a photodiode mosaic, and a resistance logic network forming a signal processing unit.

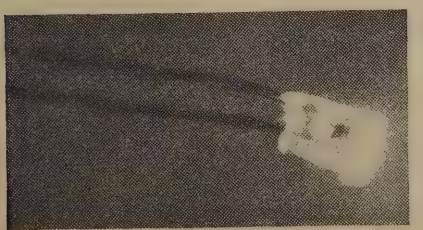
The Department of Physics will perform a number of experiments to demonstrate physical phenomena. These will include demonstrations of the Barkhausen effect (through the Curie point), Bragg's law of reflection, electron diffraction and Brownian motion.

The University of Birmingham, Edgbaston, Birmingham, 15.

BRANDENBURG (14)

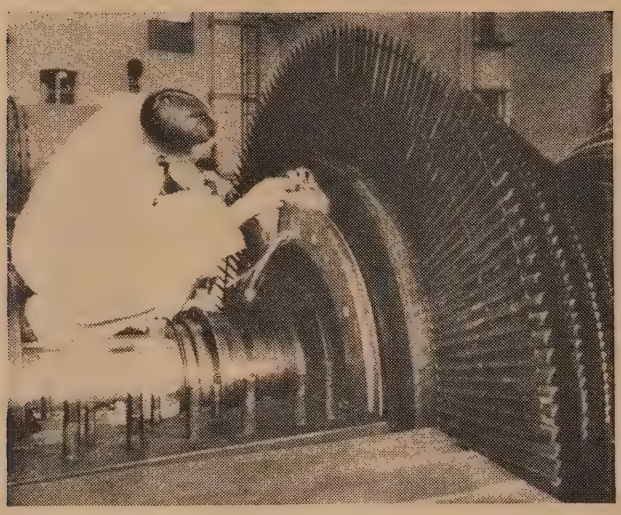
A 1 to 20kV supply unit, designed for use with electron microscopes and other similar instruments is to be displayed. It is to be shown working with a potentiometric type of pen recorder displaying its negligible drift characteristics. **4WW 307**

Brandenburg Ltd., 139 *Sanderstead Road, South Croydon, Surrey.*

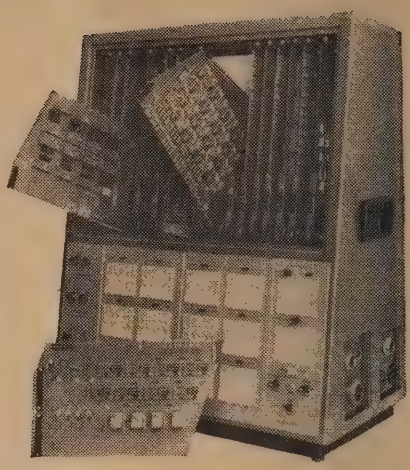


P-n junction in gallium phosphide, giving light output in forward direction. Developed by the Admiralty.

Bismuth telluride/copper thermo-junction by AMF, used in ammeters.



Radio telemetry equipment used by the Central Electricity Research Laboratories to obtain information on behaviour of turbines.



Digital data translator from Bryans

BRIGHTON COLLEGE (102)

One of the items on this stand will be an attachment for a three-terminal bridge for rapidly checking the conductance of a conducting film.

Brighton College of Technology, Moulsecoomb, Brighton 7, Sussex.

BRISTOL UNIVERSITY (81)

The H. H. Wills Physics Laboratory are to demonstrate a new photographic process based on the formation of lattice defects, charge carriers and even chemical decomposition by light in thin films of lead iodide. The method has certain advantages over conventional photography. For instance, images can be enlarged up to 1,000 times and the films, which require no processing, can be handled in daylight with complete safety.

University of Bristol, H. H. Wills Physics Laboratory, Royal Fort, Bristol 8.

BRITISH AIRCRAFT CORP. (137)

A radio-frequency extensometer for strain measurement in concrete is to be demonstrated, together with a range of miniature resistance thermometers and vibrating-diaphragm pressure transducers. In the latter, the diaphragm is maintained at resonance, variation of pressure causing a change in compliance and therefore in the resonant frequency. **4WW 308**

British Aircraft Corporation Ltd., 100, Pall Mall, London, S.W.1.

BRYANS (105)

A twin-channel digital-to-analogue converter, with buffer storage facilities, is to be demonstrated together with a portable automatic XY-TY plotting table. Information will also be available on some new prototype units which will not be at the show. These include a high-sensitivity plotting table, a twin-channel X-Y recorder and a function generator. **4WW 309**

Bryans Ltd., Willow Lane, Mitcham, Surrey.

C.N.S. INSTRUMENTS (32)

Exhibits will include the S.R.2 proportional temperature controller using a saturable reactor, the "Sirect" proportional temperature controller and a read-out extensometer which is based on a design by the National Engineering Laboratory. The bridge balance decade dials may be calibrated in terms of direct measurement or as a percentage strain of any gauge length. **4WW 310**

C.N.S. Instruments Ltd., Holmes Road, London, N.W.5.

CAMBRIDGE INSTRUMENT CO. (149)

Four prototype equipments will be displayed. A scanning electron microscope has been developed for specimens that have comparatively rough surfaces or other characteristics that make them difficult to examine, either directly or by "extraction replica" methods. A displacement transducer will be demonstrated that measures displacement over a wide range. A continuous process polarograph and a bridge unit for temperature coefficient and resistance measurements complete the stand. **4WW 311**

Cambridge Instrument Co. Ltd., Grosvenor Place, London, S.W.1.

CAMLAB (116)

An electronic vacuum microbalance designed for precise differential weighing over extended periods rather than for absolute measurement of weight is to be shown by this company. It has a capacity of 50 grammes and three read-out ranges covering from 0 to 20,000 micrograms. **4WW 312**

Camlab (Glass) Ltd., Milton Road, Cambridge.

CENTRAL ELECTRICITY RESEARCH (143)

Telemetry equipment for the study of the moving parts of rotating machines is to be exhibited, along with an instrument intended for the determination of heat transfer coefficient at fluid/solid interfaces. Also to be shown is an automatic recorder for the study of corrosion processes.

Central Electricity Research Laboratories, Cleeve Road, Leatherhead, Surrey.

D.S.I.R. (54)

Twenty-six exhibits and demonstrations from 15 associated bodies are to be shown. A demonstration of the methods used to conduct the London Noise Survey will be mounted by the Building Research Association. The National Engineering Laboratory will have a demonstration, using a digitizer and counter, of their new five-bit binary code, which is more easily converted to decimal for servicing. They will also show a hot-wire milliameter using 170 thermojunctions to give a sensitivity of 2.5mV/mW.

Department of Scientific and Industrial Research, State House, High Holborn, London, W.C.1.

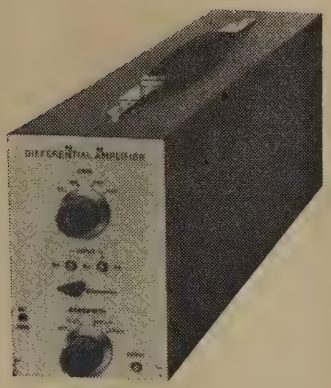
DAWE INSTRUMENTS (126)

Several newly developed instruments are to be shown. These include a precision sound level meter and analyser, an ultrasonic cleaning unit, a constant temperature anemometer, a noise-level indicator with "thermometer" display, and an acoustical-measuring system. **4WW 313**

Dawe Instruments Ltd., Western Avenue, Acton, London, W.3.

DECCA RADAR (55)

A reflectometer to be exhibited enables v.s.w.r. measurements to be made over the complete waveguide band. Only one detector is used,



A d.c. differential amplifier from Fenlow Electronics.

Ceramic thyratron (CX1157) introduced by English Electric Valve Company.

Digital multimeter manufactured by Digital Measurements Ltd.

obviating errors due to differing sensitivities, a mechanical switch being used for sampling forward and reflected energy. Electron-spin resonance equipment, a tunnel-diode 2Gc/s oscillator and a 25dB coaxial attenuator will be shown. **4WW 314**

*Decca Radar Ltd., Albert Embankment, London, S.E.*1.

DIGITAL MEASUREMENTS (33)

The digital logger which will be displayed demonstrates the collection and recording of meteorological data, but any variable which can be converted into electrical signals may be recorded. The equipment can type up to eight characters for each channel at a rate of one channel per second or punch paper tape at 1, 2, 4 or 10 channels per second. There are three modes of operation, namely, continuous scanning, single scans on command or a partial scan of the input channel selected. A digital multimeter for alternating and direct voltage and current and resistance measurements will also be shown. **4WW 315**

Digital Measurements Ltd., 25 *Salisbury Grove, Mytchett, Hants.*

E.M.I. ELECTRONICS (15)

Two new oscilloscopes, one a general-purpose instrument with a bandwidth of d.c. to 10Mc/s (−3dB) and a very sensitive d.c. coupled dual-channel instrument, are to be shown for the first time at this year's exhibition. **4WW 316**

E.M.I. Electronics Ltd., Hayes, Middlesex.

EDWARDS HIGH VACUUM (144)

Among the vacuum equipment to be seen on this stand will be the new Ion-Pirani pressure gauge operating over the range 1 to 10^{-8}torr(mm Hg) which is now being used for the deposition of micro-circuits. **4WW 317**

Edwards High Vacuum Ltd., Manor Royal, Crawley, Sussex.

EKCO ELECTRONICS (100)

A new range of transistorized counting equipment, of higher specification and complementary to the existing thermonic range is to be shown. A comprehensive autoscaler-ratemeter is to be demonstrated, to illustrate the use of some of the basic units of the new range. **4WW 318**

Ekco Electronics Ltd., Southend-on-Sea, Essex.

ELECTRICAL REMOTE CONTROL (93)

Industrial timing units are the chief products of this firm. Both electrical and pneumatic types (the latter for use in inflammable atmospheres) will be shown. **4WW 319**

Electrical Remote Control Co. Ltd., Elremco Works, Bush Fair, Harlow, Essex.

ELECTRON PHYSICAL INST. (106)

A range of electron-beam equipment will be displayed, including types for micro-etching, X-ray microscopy and X-ray diffraction. **4WW 320**

*Electron Physical Instruments Ltd., Stanley Road, Hendon, London, N.W.*1.

ELLIOTT-AUTOMATION (133, 134, 136 & 153)

The exhibit will include a computer based on Goto-pair tunnel-diode logic circuits, a helium laser, and a gallium arsenide laser working with an ultra-high-speed infra-red detector. A portable neutron generator with an output of 10^{-10} neutrons per second will also be seen. **4WW 321**

Elliott-Automation Ltd., 167 *Great Portland Street, London, W.*1.

ENGLISH ELECTRIC VALVE (58)

A new 11-in direct-viewing storage tube which has a useful viewing screen of 9.5 in diameter and is particularly suitable for the daylight viewing of radar information, is to be demonstrated. It has two electron guns, one for writing the signal on to the storage surface and the other (the flood gun) for displaying information written on the viewing screen. The flood gun is continuously operative and the information written on the screen persists for as long as 10 minutes but can be erased immediately by applying a small positive pulse to the backing electrode.

One of a range of flash discharge tubes designed for the excitation of ruby lasers will be shown working in a laser unit.

On show will also be a hydrogen-filled tetrode thyratron (CX1157), with a ceramic envelope, designed for compact medium-power radar equipment. The overall length is 3.84in, diameter 3.25in and it weighs approx. 10oz. **4WW 322**

English Electric Valve Co. Ltd., Chelmsford, Essex.

FEEDBACK (121 & 160)

Educational equipment demonstrated will include a transistor logic system consisting of small plug-in elements with a maximum operating speed of 50kc/s. An instructional servo system to be shown incorporates the elements of a complete system, with provision for variable time-constants. An 10c/s-100kc/s RC oscillator will be demonstrated which has two outputs at 90° phase difference and a variable-phase output. **4WW 323**

Feedback Ltd., Park Road, Crowborough, Sussex.

FENLOW ELECTRONICS (52)

A low-frequency spectrum analyser covering 0.3c/s to 1kc/s and a d.c. differential amplifier are the main items to be exhibited this year. The differential amplifier comprises two stabilized chopper-amplifier channels; interconnected to provide a differential input with high input im-

pedance to both common mode and differential signals. **4WW 324**

Fenlow Electronics Ltd., Springfield Lane, Weybridge, Surrey.

FIELDEN ELECTRONICS (47)

The equipment shown will include a new precision programme controller, a linear capacity/pneumatic pressure transducer and a differential pressure cell with electrical output. **4WW 325**

Fielden Electronics Ltd., Wythenshawe, Manchester 22.

FLEMING INSTRUMENTS (23)

Equipment designed for the measurement of particle size and pollution levels in the atmosphere will be exhibited. **4WW 326**

Fleming Instruments Ltd., Coxton Way, Stevenage, Herts.

G.E.C. (142)

Several demonstrations of the work undertaken by the Hirst Research Centre are to be shown. These include demonstrations on electron behaviour, the break-up of a hollow electron beam, measurement of thermal shock properties by electron bombardment, generation of pulse patterns and their properties, magnetic films for computer memories, and time parallax in binaural perception. **4WW 327**

The General Electric Co. Ltd., 1 Stanhope Gate, London, W.1.

GENEVAC (140)

Vacuum pumping and associated equipment will be presented. Two new rotary piston pumps will be shown together with an air-cooled pumping unit, a pressure gauge and a coating unit which incorporates a 2-in vacuum pump. **4WW 328**

Genevac Ltd., Pioneer Mill, Radcliffe, Lancs.

GEORGE ELLIOTT LABS. (46)

An E.M.I. vidicon camera tube, with a fibre optic faceplate, is to be displayed with other products to show the progress George Elliott Laboratories have made in the field of fibre optics. Other products to be shown include concave plano fibre optics suitable for use with image intensifiers. **4WW 329**

George Elliott Laboratories Ltd., 73 Thames Street, Sunbury-on-Thames, Middx.

GRAPHIC INSTRUMENTS (38)

Ranges of galvanometers for use in high-resolution recorders are to be exhibited, having all suspension components symmetrically disposed about the axis to increase stability. The associated recorders are small, robust, and produce a 0.002-in trace on narrow-gauge film or paper. They can also be used for colour film. **4WW 330**

Graphic Instruments (Research), Ltd., Trout Road, West Drayton, Middx.

GULTON INDUSTRIES (117)

Piezoelectric ceramics in wafers down to 0.003in thick are used in the range of electro-mechanical transducers to be seen on this stand. Pickup elements constructed of a sandwich of three plates of thin ceramic, the centre one being a high-permittivity material, are shown. The capacitance being some 20 times greater than that of more conventional elements, they are suitable for feeding directly into low-impedance transistor circuits.

Sheets of oppositely poled piezoelectric ceramic, bonded together to form a bimorph bender are used in pairs in some extremely small electrostatic relays. These benders are also usable in a piezoelectric loudspeaker. **4WW 331**

Gulton Industries (Britain), Ltd., Regent Street, Brighton 1, Sussex.

GUY'S HOSPITAL MEDICAL SCHOOL (67)

The Department of Physics will show a semiconductor d.c. amplifier developed for electrophysiological work. The amplifier is suitable for signals up to 150mV from a high-impedance source, but the bandwidth is limited to a few kc/s. The signal is applied to a bridge having two silicon junction diodes whose capacitance varies with voltage. This amplitude-modulates a carrier which in turn is amplified and rectified.

Medical School, Guy's Hospital, London Bridge, London, S.E.1.

HATFIELD INSTRUMENTS (11)

An a.c. clip-on milliammeter, designed to measure currents from 1mA to 10A over the frequency range 20c/s to 2Mc/s without disturbing the circuit under test, is to be shown. Other items to be shown include an r.f. bridge covering 50k/s to 20Mc/s and a high-performance power supply unit. **4WW 332**

Hatfield Instruments Ltd., Burrington Way, Plymouth, Devon.

IMPERIAL COLLEGE (87 & 88)

The exhibit, provided by the Department of Electrical Engineering, will show the general behaviour of a system in which a control system is used to adjust various inputs to a process to yield a maximum output and to maintain this condition for variation in the process parameters. Such systems are commonly known as "hill-climbing" systems.

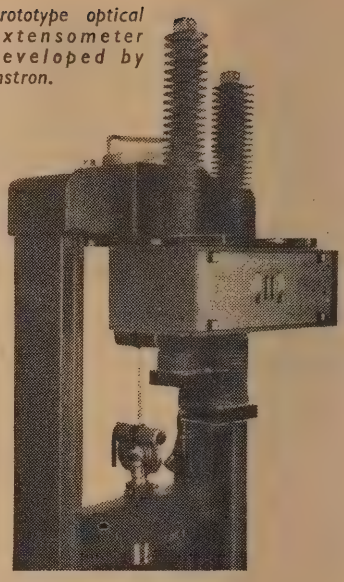
Imperial College of Science and Technology, University of London, Exhibition Road, London, S.W.7.

INERTIA SWITCH (4)

Equipment to be shown includes a brake tester in the form of an integrating decelerometer, a device to indicate the occurrence of shocks exceeding a predetermined value, and vibration switches which are sensitive to vibration amplitudes of 0.005in. **4WW 333**

Inertia Switch Ltd., 123, London Road, Camberley, Surrey.

Prototype optical extensometer developed by Instron.



INSTRON (20)

A prototype optical extensometer, designed to record automatically the extension of the gauge length of a tensile test specimen, is to be shown this year. Bench marks are painted on the specimen to establish the gauge length and the subsequent movement of each mark is followed by an electro-optical servo mechanism. **4WW 334**

Instron Ltd., Halifax Road, High Wycombe, Bucks.

INTERNATIONAL R. & D. (60)

This organization is concerned primarily with research and development and are not manufacturers. They will be demonstrating ruby laser devices applied to such fields as micro-machining and micro-welding. Some of the advantages of gas lasers in such fields as photography and microscopy will also be demonstrated. **4WW 335**

International Research & Development Co. Ltd., Fossway, Newcastle-upon-Tyne 6.

J. & P. ENGINEERING (119)

A continuously adjustable e.h.t. unit, designed to provide up to 4,000 volts at 3mA with a stability of 1 part in 10^4 is to be shown this year. The stability of the unit is demonstrated by feeding the output into a voltage drift monitor. **4WW 336**

J. & P. Engineering (Reading) Ltd., Portman House, Cardiff Road, Reading, Berks.

JOHNSON, MATTHEY & CO. (22)

The exhibit will be chiefly concerned with materials. Iron/rhodium alloys, which change from anti-ferromagnetic to ferromagnetic at 70°C will be shown. Also displayed will be an air-drying silver preparation for the application of conductive films to insulating substrates. **4WW 337**

Johnson, Matthey & Co. Ltd., 73-83 Hatton Garden, London, E.C.1.

KASAMA ELECTRONICS (40)

Two instruments will be shown. A transistor analyser Type R.K.2 and a double pulse generator Type 2/302D. This latter instrument has a square wave output of 10c/s to 1Mc/s with outputs from 0 to 100V in five ranges. Positive- or negative-going pulses can be obtained. The transistor analyser can be used for measurement of hybrid parameters in both common base and common emitter configuration. Other measurements that can be made include, leakage current range, collector turnover voltage and forward and backward characteristics of germanium or silicon diodes. **4WW 338**

Kasama Electronics Ltd., 139/149 *Fonthill Road, Finsbury Park, London, N.4.*

KENT (146)

Included in the exhibit will be an automatic titrimeter for continuous operation. In the field of mechanical measurements, a displacement transducer using a differential transformer will be demonstrated. Full-scale ranges are variable between 0.05in and 0.25in. **4WW 339**

George Kent Ltd., Biscot Road Works, Luton, Beds.

LABGEAR (84 & 152)

A decade counter Type D4151/A and a counting ratemeter Type D4152/A developed for educational applications, especially physics, are to be shown this year. A transistorized radio-microphone is also to be shown. **4WW 340**

Labgear Ltd., Cromwell Road, Cambridge.

LANGHAM THOMPSON (24)

Semiconductor strain gauges (including miniature silicon elements) and examples of experimental transducers employing these gauges are to be shown. Langham Thompson will also be exhibiting transducers for the measurement of pressure and vibration and a converter to produce from an analogue input an 8-digit binary output. **4WW 341**

J. Langham Thompson Ltd., Park Avenue, Bushey, Herts.

M-O VALVE CO. (138)

One of the major exhibits will be a working demonstration of a triggered cold-cathode gas discharge device with a rare-gas filling, which has been designed to protect equipment from flashover and other voltage breakdowns. Other new exhibits include a travelling wave tube for microwave applications and a ceramic power triode, shown working as a 500Mc/s oscillator. **4WW 342**

The M-O Valve Co. Ltd., Brook Green Works, London, W.6.

MEGATRON (41)

New cadmium-sulphide cells, a colour meter to measure colour in terms of C.I.E. co-ordinates, a street lighting photometer and photocells with a colour sensitivity similar to the "sensitivity of a human eye under night vision conditions" will be among the exhibits. **4WW 343**

Megatron Ltd., 115a Fonthill Road, London, N.4.

METALS RESEARCH (28)

The principal exhibit this year is a quantitative television microscope for measurement of inclusions, grain size, phase proportion and size distribution. A spark slicer accessory for cutting metallic single crystals is also on display and will be exhibited in position in their Servomet spark machine. **4WW 344**

Metals Research Ltd., 91 King Street, Cambridge, Cambs.

METER-FLOW (44)

A range of micro-miniature frequency discriminators for missile and aircraft applications is being introduced. The units, weighing 4oz, occupy 2 cubic inches and use transistors and printed circuits. Frequency ranges up to 40kc/s are available. **4WW 345**

Meter-flow Ltd., 606 North Feltham Trading Estate, Feltham, Middx.

MICROWAVE INSTRUMENTS (110 & 156)

A microwave moisture meter will be on show, together with a polarized-light mekometer—an instrument used for distance measurement. Electron-spin resonance equipment has been developed for use in schools and colleges. **4WW 346**

Microwave Instruments, 98 St. Pancras Way, Camden Road, London, N.W.1.

MIDDLESEX HOSPITAL MEDICAL SCHOOL (66)

The Department of Physics is preparing the exhibits. These will include a system for low-level counting of radioactive samples by source modulation and is designed to give accurate readings on low-activity samples. A machine dictionary for Chinese scientific terms will also be demonstrated. This is designed for a user with little knowledge of the language.

Middlesex Hospital Medical School, Cleveland Street, London, W.1.

MINING & CHEMICAL PRODUCTS (42)

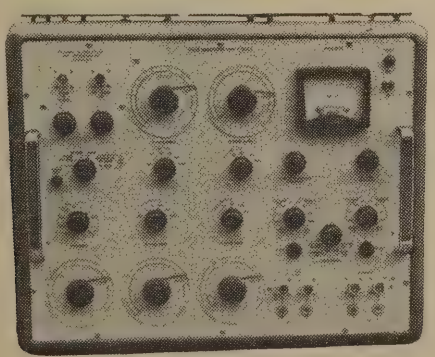
Gallium arsenide devices will be featured. One such component is a diode, infra-red emitting light source, the radiation of which can be modulated at comparatively high frequencies. Another gallium arsenide diode has a reverse leakage current of less than 10^{-11} amps. This diode is shown in a simple frequency modulation circuit as a voltage-variable capacitor. **4WW 347**

Mining and Chemical Products Ltd., Foliejon Park, Winkfield, Windsor, Berks.

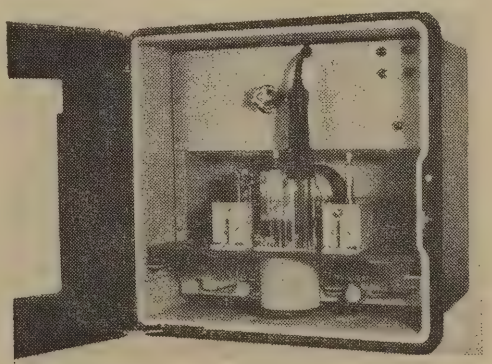
MINISTRY OF AVIATION (1)

Seven establishments of the Ministry will be participating in this joint display. Among the Royal Aircraft Establishment's demonstrations will be a gas discharge frequency multiplier. This is a microwave device in which the harmonics of the drive frequency are produced in a low-pressure gas discharge.

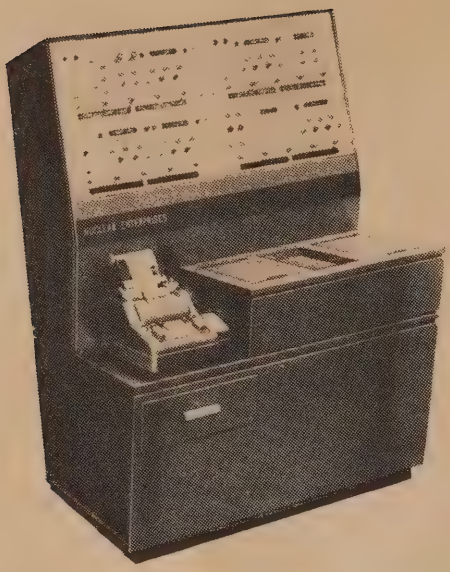
The Royal Radar Establishment will be demonstrating a thin-film, wide-band amplifier, a transistor swept-frequency oscillator for testing servomechanisms and filters, the amplification of acoustic waves in cadmium sulphide and a logarithmic

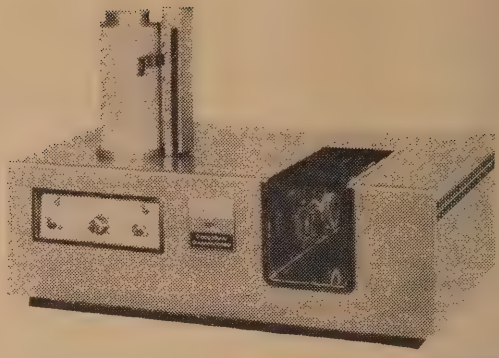


Double pulse generator Type 2/302D developed by Kasama Electronics Ltd.



Continuously sampling automatic titrimeter, intended by George Kent for quality-control applications.





Above: Low-cost, infra-red grating spectrophotometer, by Perkin Elmer.

Left: Automatic liquid scintillation spectrometer, introduced by Nuclear Enterprises.

receiver test set. This latter instrument enables the input-output characteristic of an i.f. logarithmic receiver to be displayed, or plotted, and the output measured to ±10mV.

New techniques, including reactively sputtered tantalum pentoxide capacitors and encapsulated transistors, are employed in the construction of the thin-film, wide-band (100Mc/s) 20dB amplifier.

A demonstration of frequency changing of laser radiation will be given in the section devoted to the Signals Research and Development Establishment.

Ministry of Aviation, Shell Mex House, Strand, London, W.C.2.

MUIRHEAD & CO. (124)

Apparatus for environmental testing of synchros is to be shown. Other instruments will include an automatic recording wave analyser and a digital read-out system. **4WW 348**

Muirhead & Co. Ltd., Beckenham, Kent.

MULLARD (118, 148 & 165)

Exhibits from the research laboratories will include the transluxor (a light-operated, solid-state amplifying device), an S-band tunnel-diode amplifier, and a u.h.f. wide-band amplifier. Equipment concerned with thin-film storage will also be shown. The development laboratories are to show an electroluminescent radar display and a mass-spectrometer leak detector. The Mullard educational service will be represented. **4WW 349**

Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.

NATIONAL COAL BOARD (132)

The Scientific Department of the board will display their experimental, prototype ash-monitoring equipment which makes use of the back-scattering of low-energy X-radiation. The sample is ground to less than 1mm and is carried past the source on a plastic belt. The back-scattered radiation is detected by a scintillation counter.

National Coal Board, Queensborough House, Albert Embankment, London, S.E.1.

NATIONAL INSTITUTE FOR MEDICAL RESEARCH (112)

A number of research units will be showing current projects. The Cyclotron Unit will demonstrate a simple, compact radiation-measuring equipment using cadmium sulphide crystals. A positron camera being shown, makes use of the annihilation radiation of positron-emitting radioisotopes to form an image of the source. A patient automatic data recording equipment (PADRE) developed at the Division of Human Physiology is essentially an information handling system which is capable in its present form of collecting five items of information from ten separate sources. Also to be shown is an apparatus for the moisture determination of biological standards and a high-speed scanning spectrophotometer.

Medical Research Council, National Institute for Medical Research, Mill Hill, London, N.W.7.

NEWPORT INSTRUMENTS (92)

A magnet power supply having a current stability of ±1 part in 10^5 at 20kW is to be introduced. Transistors are employed for stabilization and the use of a rotary generator avoids output transients due to mains fluctuations. A proton-resonance magnetometer, working at 100Mc/s for the measurement of fields up to 25 kilogauss will be shown. **4WW 350**

Newport Instruments (Scientific & Mobile) Ltd., Newport Pagnell, Bucks.

NUCLEAR ENTERPRISES (73)

The exhibit will include a dual-channel, automatic, liquid scintillation spectrometer and turntable unit for measurements on tritium, carbon-14, iron-55 and other isotopes. The detector unit of a whole-body monitor for clinical applications, using a transistorized control unit is also to be shown. **4WW 351**

Nuclear Enterprises (G.B.) Ltd., Sighthill, Edinburgh 11.

OXFORD INSTRUMENT CO. (79)

This company will show examples of their work on superconducting magnets and associated cryogenic equipment. A complete cryomagnetic system (the Type L.1000) will be demonstrated with the magnet in

A standard, 40 kilogauss, 1.5cm (inner diameter) superconducting magnet (Oxford Instrument Co. Ltd.) being raised from its cooling bath after testing.

continuous operation. A light, high-strength glass fibre case to house a 2MW conventional copper solenoid producing fields from 50 to 130 kilo-

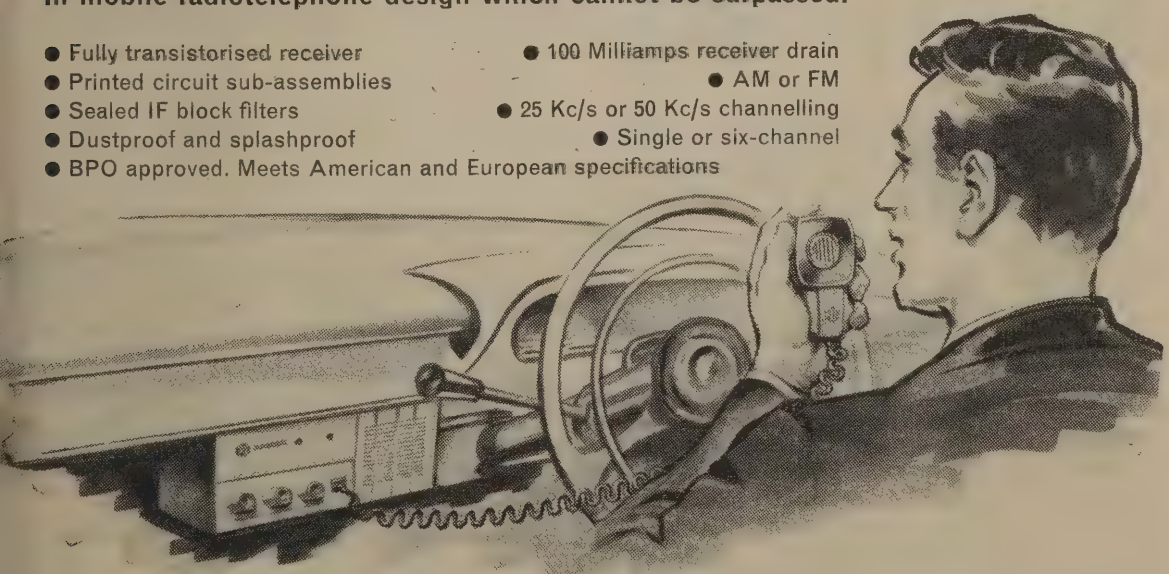
(*continued on page* 19)

PYE introduce the brilliant new 'CAMBRIDGE'

Transistor Mobile Radiotelephone

The overwhelming advantages of the fully transistorised receiver have now been made available in this remarkable new mobile radiotelephone, at no additional cost and without sacrifice of the stringent performance requirements hitherto met only by valve receivers. This outstanding Pye product sets a new high standard in mobile radiotelephone design which cannot be surpassed.

- Fully transistorised receiver
- Printed circuit sub-assemblies
- Sealed IF block filters
- Dustproof and splashproof
- BPO approved. Meets American and European specifications
- 100 Milliamps receiver drain
- AM or FM
- 25 Kc/s or 50 Kc/s channelling
- Single or six-channel

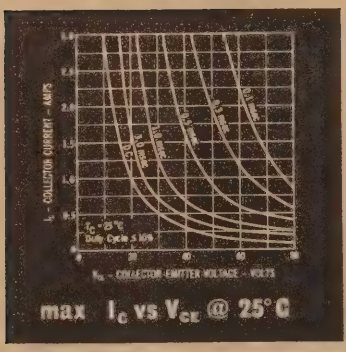


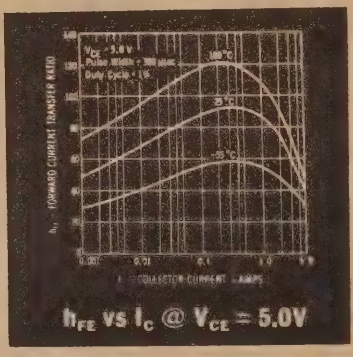
PYE TELECOMMUNICATIONS LTD. · CAMBRIDGE · ENGLAND · TEL: TEVERSHAM 3131

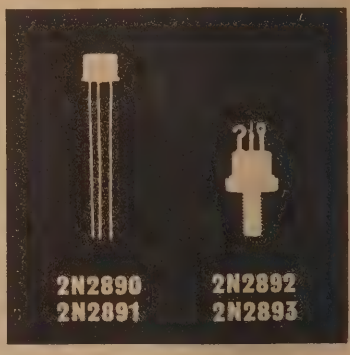
4WW—091 FOR FURTHER DETAILS

D

PLANAR EPITAXIAL POWER TRANSISTORS







Power - 30 W dissipation @ 25°C
V_{CE}(sat)-0.75 V max. @ **I_C-2A**
I_{CBO}-0.1 μA max. @ **V_{CB}-60V**
LV_{CEO}-80V min. @ **I_C-100mA**
h_{FE}-50-150 @ I_C-1.0 A, V_{CE}-2V

Now it is possible to design Planar transistors into your power applications. Take advantage of the advanced reliability, stability and performance offered by transistors manufactured by this S G S process. SGS's Planar epitaxial power transistors have the interdigitated configuration shown at left, and are available in medium and high beta ranges in the packages listed.

JEDEC TO-5 KOVAR 7/16" HEXAGONAL STUD

2N2890, h_{FE} : 30-90
2N2891, h_{FE} : 50-150
2N2892, h_{FE} : 30-90
2N2893, h_{FE} : 50-150

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4WW—092 FOR FURTHER DETAILS.

gauss will be exhibited. The case has to withstand the pressure of the cooling water, which could be up to 150lb/sq in. **4WW 352**

The Oxford Instrument Company Ltd., 27 Northmoor Road, Oxford.

OXFORD UNIVERSITY (80)

A superconducting solenoid—constructed by the Oxford Instrument Company—immersed in a bath of liquid helium is to be demonstrated this year to show the applications of superconductors for loss-free energy storage.

University of Oxford, Department of Physics, Clarendon Laboratory, Parks Road, Oxford.

PANAX EQUIPMENT (141 & 151)

This company's display will consist mainly of working demonstrations of their latest nucleonic measuring equipment. A demonstration kit for schools covering ten basic experiments in radioactivity will also be shown. **4WW 353**

Panax Equipment Ltd., Holmethorpe Industrial Estate, Redhill, Surrey.

PERKIN-ELMER (91)

The exhibit will be based on a low-cost infra-red grating spectrophotometer. The complete infra-red region, from 2.5 to 25 microns is covered, and a direct record is given of percentage absorption against a linear wavelength scale. Variable scan speeds are available and the drive will cover the whole range in from 6 to 56 minutes. **4WW 354**

Perkin-Elmer Ltd., Beaconsfield, Bucks.

PLANER (98)

Apparatus will be shown for the evaluation of the figure of merit of thermoelectric materials for use at temperatures of up to 600°C. A steady-state, absolute method is employed, thermal conductivity, Seebeck coefficient and electrical conductivity measurements being carried out on the same test specimen without withdrawal from the apparatus. A number of high-temperature, thermoelectric generator materials will be included on the stand. **4WW 355**

G. V. Planer Ltd., Windmill Road, Sunbury-on-Thames, Middx.

PLESSEY (10)

An electronic microbalance covering the range 5 to 500mgm is to be shown this year. Other products to be shown include a permanent magnet assembly for ion pump applications, a new sound velocity meter for use in bathythermograph applications and oceanography, and a ferrite v.h.f. inductor. Variable v.h.f. ferrite inductors operating at 500Mc/s are to be demonstrated. **4WW 356**

The Plessey Company (U.K.) Ltd., Ilford, Essex.

PULLIN (108)

The prototype recording densitometer to be shown by Pullin is an automatic instrument capable of measuring a large number of radiation monitoring films and feeding the output to a computer for "dose" assessment. They are also showing the prototype of a digital display unit which provides for the decimal display of four digital codes commonly used in metering systems. **4WW 357**

R. B. Pullin & Co. Ltd., Great West Road, Brentford, Middx.

PYE, W. G. (85)

A new microcapillary electrode assembly is to be demonstrated with other radiochromatography equipment. It is to be shown working in conjunction with an extremely accurate pH meter. **4WW 358**

W. G. Pye & Co. Ltd., York Street, Cambridge.

QUEEN MARY COLLEGE (70)

Electrical filters are easily constructed to pass low frequencies and to reject higher ones. A multi-dielectric-layer optical filter can similarly be optimized, the method being applicable to any spectral region. The principles will be illustrated by the Department of Electrical Engineering at the exhibition by models in 3-cm waveguide.

Queen Mary College, University of London, Mile-End Road, E.1.

RESEARCH ELECTRONICS (72 & 154)

The stand will be divided into two sections. The educational section will consist of simplified and inexpensive nucleonic equipment such as ratemeters and scalers, etc. The main section will be devoted to an entirely new range of transistor nucleonic instruments based on a plug-in, modular design. **4WW 359**

Research Electronics Ltd., Bradford Road, Cleckheaton, Yorks.

RESEARCH & ENGINEERING CONTROLS (94)

Temperature and pressure transducers and control equipment are to be demonstrated by this company. The equipment includes a precision comparison bridge for resistance thermometry, aircraft temperature sensors using platinum resistance thermometers and a proportional temperature controller. This latter instrument uses s.c.r.s connected across a bridge rectifier circuit in series with the load. **4WW 360**

Research & Engineering Controls Ltd., South Bersted Industrial Estate, Bognor Regis, Sussex.

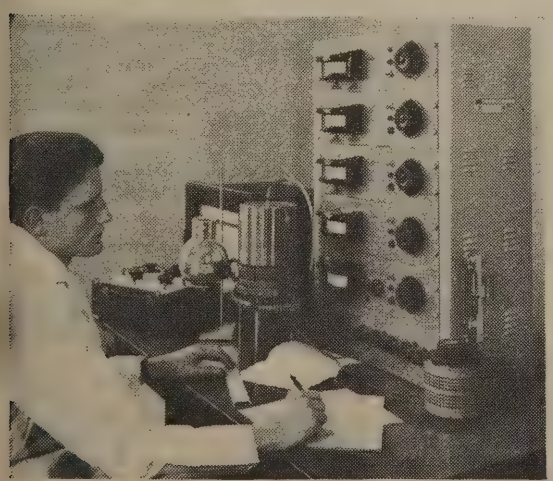
RESEARCH & INDUSTRIAL INSTS. (57)

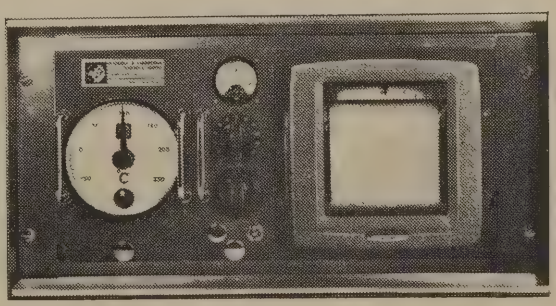
An electromicrobalance, designed to weigh up to 200mgm directly in single-pan operation and differentially up to a total of 5.5 grammes on both pans, is to be shown. Another item to be shown is an interferometer covering the far infra-red wavelength range 20 to 1,000 microns. **4WW 361**

Research and Industrial Instruments Company, 116 Lordship Lane, London, S.E.22.

ROLLS-ROYCE (59)

The development of a technique for coating silica fibres with aluminium alloy has made possible the production of fibre-reinforced metal, which will be exhibited. The material has





Above: Proportional temperature controller (Research and Engineering Controls).

Left: Apparatus developed by G. V. Planer Ltd. for the evaluation of the figure of merit of thermoelectric materials for use at temperatures up to 600°C.

high strength at elevated temperatures as the fibre bears the load even when the aluminium would flow under load. **4WW 362**

Rolls-Royce Ltd., Old Hall, Littleover, Derby.

ROYAL INFIRMARY, EDINBURGH (68)

The Department of Medical Physics will show a printed circuit electrode for electroencephalograph recording from the surface of the brain. The electrode is constructed by sputtering gold on to a thin plastic film through a grid. They will also show a miniature radio telemetering device for cardiac monitoring using a metal reed as the transducer.

The Royal Infirmary, Edinburgh 3.

ROYAL MILITARY COLLEGE OF SCIENCE (65)

Several of the exhibits are teaching aids including a three-dimensional model demonstrating the various possible modes of vibration of the atoms in a complex molecule. An electronic switching circuit controls the "modes."

Royal Military College of Science, Physics Branch, Shrivenham, Swindon, Wilts.

ROYSTON INSTRUMENTS (48)

Several specialist tape recorders are to be exhibited together with playback and "de-multiplexing" equipment. One of these machines, a miniature demand recorder (magnetic), has been designed to automate the process of statistical study of the consumption of electricity by various types of users. **4WW 363**

Royston Instruments Ltd., Canada Road, Byfleet, Surrey.

S.E. LABORATORIES (25)

Several pieces of electronic apparatus are to be shown this year. Among these is a transistorized synchro converter for converting synchro outputs to analogue signals for indication, computing or control. Another is an air flowmeter system, using variable-reluctance-type pressure transducers and a miniature transistorized computer. **4WW 364**

S.E. Laboratories (Engineering) Ltd., North Feltham Trading Estate, Feltham, Middx.

SAFETY IN MINES RESEARCH ESTABLISHMENT (125)

Two demonstrations will be provided. A recently developed shutter for preventing multiple exposures in high-speed, rotating-mirror cameras and an instrument for measuring respirable dust. In the first-mentioned exhibit, the shutter assembly and associated electronic equipment will be operated in conjunction with a simulated rotating mirror.

Safety in Mines Research Establishment, Red Hill, Off Broad Lane, Sheffield 3.

SANGAMO WESTON (122)

A diaphragm inductive pressure indicating system, comprising a transducer electrically connected to a moving-coil indicating instrument and designed for use in aircraft, is to be shown together with a multi-range temperature measuring instrument. **4WW 365**

Sangamo Weston Ltd., St. Georges Court, 22-26 New Oxford Street, London, W.C.1.

SHANDON (78)

The apparatus will be mainly that associated with gas chromatography and electrophoresis techniques. A new universal ultra-violet cabinet designed to facilitate the examination of paper chromatograms will be demonstrated. It has facilities for photographic recording. **4WW 366**

Shandon, 65 Pound Lane, London, N.W.10.

SIMON-CARVES (86)

A radiation detector, using a crystal and photomultiplier head and a digital counter for display, is to be shown. Other items to be exhibited include a centrifugal particle size analyser and an automatic bacterial colony counter. Simon-Carves is a member company of Simon Engineering Ltd. **4WW 367**

Simon-Carves Ltd., Cheadle Heath, Stockport, Cheshire.

SOUTHERN ANALYTICAL (2)

Among the new equipments, a new polarograph, the A1670 Davis-Southern cathode ray polarograph, will be shown. Also included will be a suspended solids recorder and a new type of flame photometer which has automatic background compensation. This improves the limit of detection while retaining the simplicity of operation required for routine analysis. **4WW 368**

Southern Analytical Ltd., Camberley, Surrey.

SPECTO AVIONICS (45)

A demonstration is to be given of an electronic integrated display system, whereby an observer is presented with several channels of information in an easily assimilable form. The equipment is intended to aid operators in charge of controlling and checking processes. **4WW 369**

Specto Avionics Ltd., Hanworth Air Park, Feltham, Middx.

SPERRY (3)

Demonstrations showing the applications of fibre optic elements as mechanical filters responding to discrete audio frequencies, new developments in non-electrical chemical plating of non-metallic substrates and a new solid-state synchro to digital converter are to be included in this year's exhibits. **4WW 370**

Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middx.

SUNDERLAND TECHNICAL COLLEGE (63)

The Electrical Engineering Department of the college will display two of their current research projects. The first is a function generator for functions of two variables, which is intended for use with an analogue computer representing a process which depends on two variables. The other exhibit is a transport delay simulator which is an electronic model of the delay which occurs when fluids flow through long pipes.

Sunderland Technical College, Sunderland, Co. Durham.

TELCON METALS (104)

The dynamic hysteresis loop plotter developed by the company's research laboratory produces on paper the dynamic B-H loops of magnetic cores at frequencies between 50c/s and 5kc/s. The H and B waveforms are sampled simultaneously for periods of about 2μsec and the resulting pulses are stretched to obtain d.c. levels which are fed to the X and Y inputs of the plotter. **4WW 371**

Telcon Metals Ltd., P.O. Box 12, Manor Royal, Crawley, Sussex.

TELEQUIPMENT (162)

A new single-beam oscilloscope with a five-inch tube is to be shown this year. Called the S51E, it has a bandwidth of d.c. to 3Mc/s and its dimensions are 7×8×15in. **4WW 372**

Telequipment Ltd., 313 Chase Road, Southgate, London, N.14.

THERMAL SYNDICATE (19)

A ruby laser system and a helium-neon gas laser unit developed in collaboration with the International Research and Development Co., Ltd., are to be demonstrated. **4WW 373**

Thermal Syndicate Ltd., P.O. Box No. 6, Wallsend, Northumberland.

TINSLEY (123)

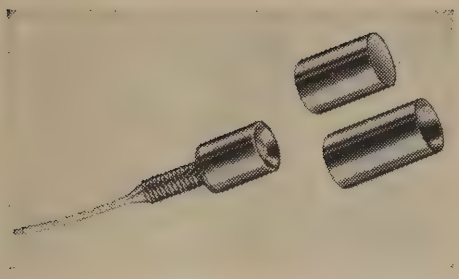
Two prototype instruments will be demonstrated. The Wheatstone bridge Type 5577 is a 6-dial bridge with switch contacts in parallel to reduce resistance to a negligible level. Conductance dials are used in place of series resistance dials. The lowest stud reading is 0.0001Ω and the accuracy at 20°C is 1 part in 100,000 of the maximum reading. An inductive ratiometer Type 5575A is intended to replace the resistance bridges normally used in resistance thermometry. The discrimination is to 1 part in 10^7. Normal operation is at 1kc/s. **4WW 374**

H. Tinsley and Co. Ltd., Werndee Hall, South Norwood, London S.E.25.

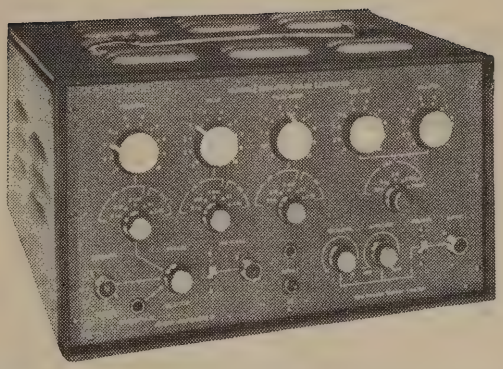
TOWNSON & MERCER (114)

The thermistor bridge control incorporated in the new range of thermostat baths to be exhibited, is an a.c. bridge the sensing arm of which is a sensitive dual thermistor mounted in the bath liquid. Amplified out-of-balance voltages from this bridge operate the thermostat heater via an s.c.r. **4WW 375**

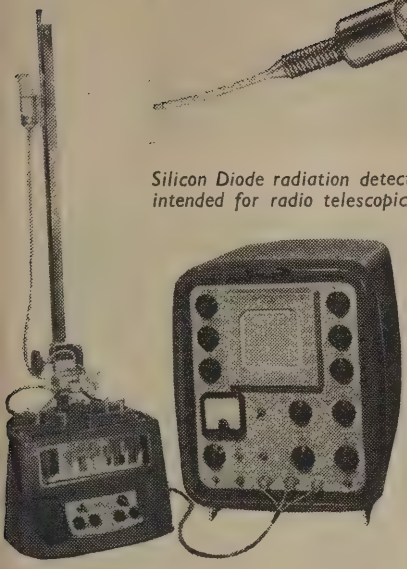
Townson & Mercer Ltd., Croydon.



Silicon Diode radiation detector, by 20th Century, intended for radio telescopic work.



Venner variable-rise-time pulse generator.



Type AT670 Davis-Southern cathode ray polarograph.

Electromicrobalance from Research and Industrial Instruments. (See page 19)

20TH CENTURY ELECTRONICS (135 & 158)

A fully-automatic leak detector for small components will be shown. Small sealed components such as transistors which are filled with helium during manufacture are automatically tested and sorted according to their leak rates, which may be as low as 10^{-8} cubic centimetres per second. The heart of the instrument is an improved type of mass spectrometer. A series of instruments for use in schools and colleges has been designed, in collaboration with the Nuffield Foundation. **4WW 376**

20th Century Electronics Ltd., King Henry's Drive, New Addington, Croydon, Surrey.

ULTRASONOSCOPE (71)

The latest developments in the range of ultrasonic flaw detectors are to be demonstrated, including fully-transistorized, wide-band equipment. The company has under development a range of glass-insulated microwire in gold, silver and lead for use in cryogenics and semiconductor devices. **4WW 377**

Ultrasonoscope Co. (London) Ltd., Sudbourne Road, London, S.W.2.

UNIVERSITY COLLEGE OF N. WALES (62)

Two d.c. motors will be shown. One, a linear type, is expected to have an efficiency which is high and comparable to that of a rotary motor. The other is a brushless rotary machine in which the commutation of the armature current is carried out by semiconductors. Visitors will also be able to see two parametric devices. A travelling-wave parametric amplifier will be demonstrated together with a parametric delay line for signal processing.

University College of North Wales, Bangor, Caerns.

VACUUM REFLEX (76)

Sonar beacons and other ultrasonic equipment are being featured by Vacuum Reflex who are participating in the exhibition for the first time. Two types of sonar beacons for use as sea bed markers for geophysical surveys are to be shown; one a continuously transmitting "pinger" type and the other a transponder. Both use ceramic transducers which are moulded integral with the epoxy resin and glass-fibre body. An ultrasonic underwater transmission system for both telemetering and voice communication over distances of several miles, and ultrasonic transducers will also be shown. **4WW 378**

Vacuum Reflex Ltd., 6 Soho Street, London, W.1.

VENNER ELECTRONICS (29)

Among the range of instruments to be demonstrated is a new variable-rise-time pulse generator. The instrument covers the frequency range 10c/s to 1Mc/s and the manufacturers claim that every parameter of the pulse can be altered. Also to be shown is a prototype 50Mc/s frequency meter with facilities for time measurements to 0.1μsec. **4WW 379**

Venner Electronics Ltd., Kingston-By-Pass, New Malden, Surrey.

WAR OFFICE (6)

A method of movement control and position measurement for machine tools will be shown. A line-following system is used, whereby an image of the line is shared by two photocells, any unbalance being used to feed error-correcting servos, or position indicators.

The War Office, Whitehall, London, S.W.1.

WATSON & SONS (83)

To overcome the reduction of life of some television camera tubes when used for microscope applications in the vertical plane, a television eyepiece which allows a camera to be used horizontally is to be shown. This is achieved by deflecting the image-forming beam from the objective through 90°. A pointer is incorporated with controls on the eyepiece. **4WW 380**

W. Watson & Sons Ltd., Barnet, Herts.

WOOD & SON (164)

"Ealing" kits will be exhibited. These include apparatus for the determination of e/m of protons and electrons, magnetic resonance apparatus and other nuclear physics equipment. If coil winding and welding facilities are not available, parts of the kits can be obtained in "sub-assembly" form. **4WW 381**

Hugh Wood and Son Ltd., 23 Leman Street, London, E.1.

WRAY (107)

A range of copying lenses developed especially for producing micro-miniaturized printed circuits and an "inverting telescope" for improving the collimation of a laser beam are to be shown. **4WW 382**

Wray (Optical Works) Ltd., Ashgrove Road, Bromley, Kent.

WORLD OF WIRELESS

BBC-2 Test Transmissions

TRADE TEST 625-line transmissions from the B.B.C.'s London television station at Crystal Palace are to restart on 4th January. These are to assist the radio trade in the installation of receivers and aerials for reception of the second programme, BBC-2, which starts in London on 20th April. The test transmissions will be on Channel 33 (vision 567.25 Mc/s; sound 573.25 Mc/s) with horizontal polarization and will take place as follows: Mondays to Fridays 9 a.m. to 1 p.m. and 2 p.m. to 8 p.m., and Saturdays 9 a.m. to 8 p.m.

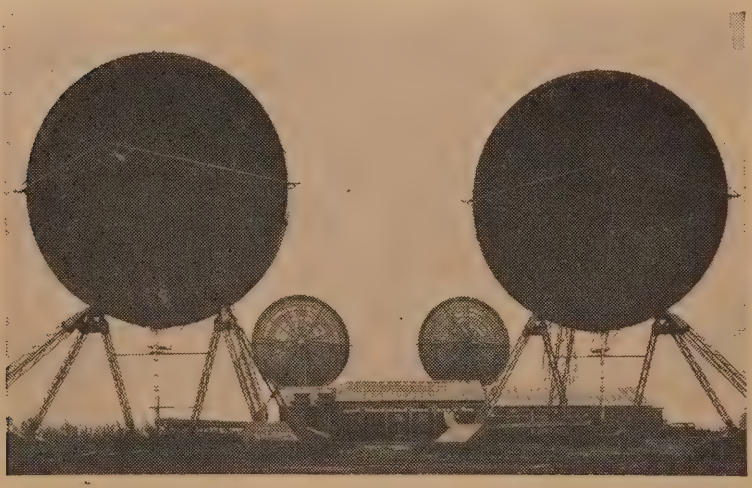
The nominal effective radiated power will be 500 kW when the installation of the new transmitting aerial is completed—about the beginning of March. Until then the e.r.p. is expected to be about 250 kW. Every effort will be made to maintain continuity of transmission, but there may be interruptions and variations in power during the installation period. The test transmissions will consist of periods of test card, with 400 c/s tone or music, alternating with periods of film chosen to give some entertainment to viewers who have u.h.f. receivers.

Interference from Medical Apparatus

REGULATIONS covering the control of radio and television interference from electro-medical apparatus have been laid before Parliament and come into force at the end of next November. The new regulations* are based on the recommendations of the Postmaster General's Advisory Committee on Wireless Interference from Industrial, Scientific and Medical Equipment.

The regulations require manufacturers, and importers, of electro-medical r.f. apparatus to ensure that under normal working conditions equipment does not exceed the prescribed limits of radiated field strength and terminal voltage. The Postmaster General has also prescribed limits for "users" but they will be invoked only in the exceptional case where undue radiation has occurred despite compliance with the manufacturers' limits.

* Wireless Telegraphy (Control of Interference from Electro-Medical Apparatus) Regulations 1963, S.I.1895, H.M.S.O.



Double Anniversary

THE Mullard valve factory at Blackburn celebrated its 25th anniversary last November at a party which also did honour to the founder of the company, S. R. Mullard, M.B.E., M.I.E.E., on his 80th birthday. It

happened that a short while before this event the 500 millionth valve (a small TV receiver type) came off the production lines of the Blackburn plant and this was reserved and specially mounted inside one of the firm's original silica transmitting valve designs as a memento of the occasion. Mr. Mullard said that he pictured some future historian examining the device and trying to imagine what sort of circuit was used with it! Among other birthday gifts was a gold watch from some of his contemporaries and many friends in the radio and electronics industry.

Ace High Network

THE last link in N.A.T.O.'s Ace High communications network, which runs from northern Norway to eastern Turkey, has now been completed and accepted by Supreme Headquarters Allied Powers Europe. The network, consisting of 82 stations divided almost equally between tropospheric forward scatter and line-of-sight links, runs through Norway, Denmark, west Germany, Great Britain, Netherlands, France, Italy, Greece and Turkey. The control centre is some 40 miles north of Paris. The International Telephone and Telegraph Corporation designed and engineered the 8,300-mile network which provides 36 channels each capable of carrying up to 18 telegraph circuits. Standard Telephones and Cables Ltd., a subsidiary of I.T.T., supplied over a £1M worth of multiplex equipment. The four 65-ft dishes shown here are at the troposcatter station in southern England.

Radio Show Trade Days

THE period of the 1964 National Radio and Television Show at Earls Court has been extended to allow for two trade days, during which admission will be limited to bona-fide members of the trade. It will now run from 24th August to 5th September, the trade days being the first two. The organizers, Radio Industry Exhibitions, are also arranging for trade periods in the mornings on most of the other days. The official opening of the show will be on the first "public" day, Wednesday 26th.

Radar Trap Detectors.—The P.M.G. has announced that he will not grant licences for receivers to detect police radar traps and that their unlicensed use is illegal.

Radio Manx.—The P.M.G. has agreed in principle to the building of a commercial sound broadcasting station on the Isle of Man providing that signals are not receivable on the mainland. No licence has yet been granted but the island's Lt. Governor has appointed Pye of Cambridge as technical consultants for the station, to be known as Radio Manx, which it is planned to open this summer.

The I.E.E. and the Brit.I.R.E. are arranging a joint one-day symposium on "**Electronics in the automobile industry**" on 7th April. It will take place in the Electrical Engineering Department, University of Birmingham, and further details and registration forms may be obtained from G. K. Steel, College of Advanced Technology, Gosta Green, Birmingham 4.

R.S.G.B. membership increased by 586 during the year ended last June, bringing the total to 11,721. Of this total 7,155 are licensed transmitters. The total number of amateur (sound) licences in force in the U.K. at 30th June was 10,118.

The Geoffrey Parr Award introduced a few months ago by the Television Society to commemorate the late Geoffrey Parr, the Society's honorary secretary for many years, is to be presented for the first time in May. Application forms giving the rules governing nominations are now available from the Society at 166 Shaftesbury Avenue, W.C.2, and have to be returned by the 15th February. This international award is for presentation annually to an individual or team for an outstanding contribution to television engineering during the preceding three years.

F.M. Broadcasting in the U.S.—The Federal Communications Commission, which called a halt temporarily to the extension of f.m. broadcasting at the end of 1962, when there were nearly 1,100 transmitters in operation, has now introduced a new plan providing for 2,380 stations at 1,858 localities.

In preparation for the **African LF/MF Broadcasting Conference** to be held in Madrid in September, a meeting of experts "to establish the technical data required for this conference" is to begin in Geneva on the 20th January. The September conference will be a joint meeting of the administration in the African Region and the European Broadcasting Area.

"**Modulation and the transmission of information**" is the title of a series of eight lectures to be given at the Borough Polytechnic, Borough Road, London, S.E.1, on Thursday evenings from 30th January. (Fee 50s.)

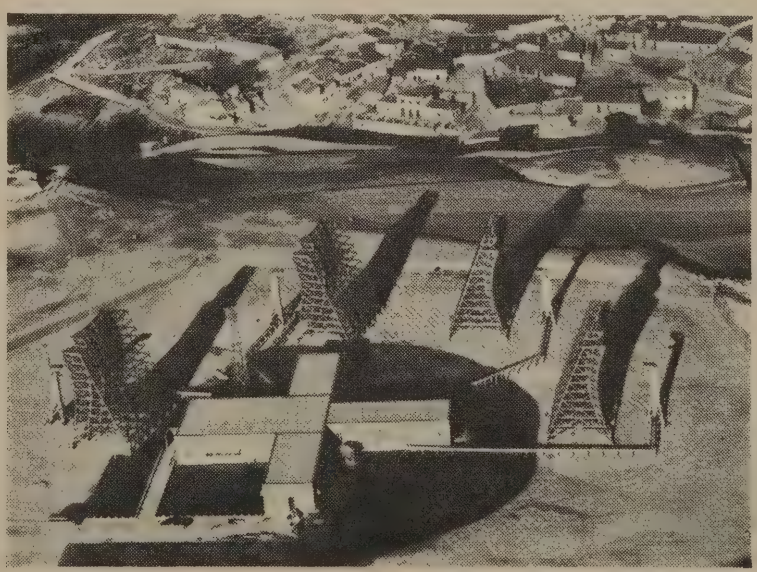
A course of eight lectures on "**625 lines and colour**" is to be given at the Hendon College of Technology, London, N.W.4, on successive Mondays from 27th January. (Fee £1.)

Colour Television Lectures.—A course of ten weekly lectures on colour television starts at the Technical College, Southall, Middx., on 15th January. (Fee £1.)

A course of twelve evening lectures on "**Transistor circuit design**" is to start on 13th January at the Twickenham College of Technology, Egerton Road, Twickenham, Middx. (Fee 30s.)

"**D.C. Inverter for Electric Shavers.**"—On page 626 of this article in the December 1963 issue the groups of waveforms of collector voltage and current in Figs. 3 and 5 should be interchanged.

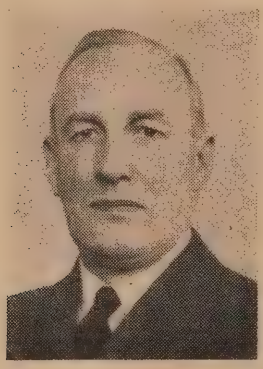
We are asked, by the author of the article on the **3-W transistor audio amplifier** in our December issue, to point out that Q3 should be a Newmarket type NKT774, not NKT274.



An impressive picture of the tropo-scatter array near Humosa, in Northern Spain, which forms part of a chain of stations in Western Europe for the U.S. Air Force. The reflectors and the feed horns for this station and others in the chain were produced by Painter Brothers, a member of the B.I.C.C. Group.

PERSONALITIES

Air Vice-Marshal Sir Walter Pretty, K.B.E., C.B., Air Officer Commanding-in-Chief, Signals Command R.A.F. for the past two years, is to be Deputy Chief of the Defence Staff (Personnel and Logistics) from March. Sir Walter, who was knighted in 1962, was deputy director of radar at the Air Ministry in 1944 and in the following year became chief signals officer, Fighter Command R.A.F. In 1951 he was appointed director of electronics research and development (air) in the Ministry of Supply. The new A.O.C.-in-C. Signals, will be **Air Vice-Marshal T. U. C. Shirley,** C.B., C.B.E., M.I.E.E., who has been



A. V-M. T. U. C. Shirley

deputy controller of electronics at the Ministry of Aviation for the past three years. He joined the R.A.F. as an aircraft apprentice in 1925. In 1946 he was appointed deputy director of signals at the Air Ministry and in 1951 became director of radio engineering. Two years later he went to Fighter Command as chief signals officer.

G. H. W. Johnson, Assoc.Brit.-I.R.E., is the new contracts manager of the Marconi International Marine Company, which he joined in 1938 as a radio officer in the *Duchess of Atholl*. Four years later he was transferred to the shore staff and in 1943 went to Oban to establish a base to serve wartime convoys. After service both abroad and in the U.K. he was appointed marine director of Marconi (South Africa) Ltd. in 1957 and in 1960 became chief executive and director of Norsk Marconikompani A/S, Norway. For the past year Mr. Johnson has been management executive at Chelmsford. He is succeeding **J. R. C. Johnson** (not related) who is retiring on 31st December after 46 years' service with the company. He served as a radio officer afloat for 32 years (including service in both wars) and had been contracts manager for the past ten years.

J. Kirkby, works director of Baird Television Ltd. since 1956, has been appointed deputy managing director. He has been with the company since 1945 having previously spent several years with A.C. Cossor Ltd.

A. B. Bamford, B.Sc., A.M.I.E.E., technical director of Baird Television for the past two years, has been appointed technical adviser to the Radio Rentals Group of which Baird is a member. Mr. Bamford, who is 41, is a graduate of Birmingham University. For 20 years prior to joining Baird in 1962 he was with Ultra latterly on the board.

A. R. A. Rendall, O.B.E., Ph.D., B.Sc., M.I.E.E., is retiring on 31st December as head of the Designs Department of the B.B.C.'s Engineering Division, a post he has held since 1950. Dr. Rendall, a graduate of King's College, London, spent thirteen years in industry before joining the B.B.C. in 1935 as an engineer in the Lines Department.

S. N. Watson

He is succeeded by **S. N. Watson,** M.I.E.E., who has been head of the television group of the same department since 1951. Mr. Watson joined the B.B.C. in 1933 and was in the Lines Department before joining the Designs Department in 1947.

H. Andrewes, O.B.E., B.Sc., M.I.E.E., technical sales executive of the Dubilier Condenser Company, retired at the end of November. After graduating in engineering at the City and Guilds College, he did

H. Andrewes

a year's post-graduate study and received the Diploma of Imperial College. He joined Dubilier as assistant to the chief engineer in 1923 but left the company in 1930 to join Dr. Robinson in the British Radiostat Corporation and was later concerned with recording developments. Mr. Andrewes joined the R.A.F.V.R. in 1939. In 1942 he was posted to India and became chief radar officer, Base Air Forces in New Delhi attaining the rank of Wing Commander. He rejoined Dubilier as laboratory manager in 1945 and six years later took charge of the Industrial Electronic Sales Department. The suppression of radio interference has been one of his special interests and he represented the R.E.C.M.F. at the Plenary Conferences of the International Special Committee on Radio Interference in 1958 and 1961.

Four of the recent grants made by the Paul Instrument Fund Committee are for the design, development or construction of electronic apparatus. **A. H. W. Beck,** lecturer in engineering at Cambridge University, has been granted £12,800 for the construction of apparatus for the amplification and generation of extremely high-frequency electromagnetic waves (below 1 mm); **Dr. T. H. Wilmshurst,** of the Department of Electronics at Southampton University, is awarded £2,300 for the construction of an electron spin

resonance spectrometer for examining short-lived paramagnetic species produced by a pulsed light source; **Dr. E. T. Hall,** director of the research laboratory for archæology and the history of art at Oxford University, is to receive £1,870 for the development of a transistor differential flux-gate magnetometer and a miniature flux-gate compass; and **Dr. S. Evans,** senior assistant in polar research at Cambridge University, has been given a supplementary grant of £1,000 for the development of an instrument for measuring the depth of continental ice sheets by a radar technique. The Paul Instrument Fund is administered by a joint committee of representatives of the Royal Society, the Institute of Physics & Physical Society and the I.E.E.

Gp. Capt. Kenneth B. S. Willder, C.B.E., B.Sc., M.I.E.E., has become director of telecommunications at the Air Ministry with the acting rank of Air Commodore. Commissioned in 1940, at the age of 22, he served at the Air Ministry during the war and became chief signals officer at Air H.Q. Iraq in 1946. He has served at the headquarters of both Bomber and Fighter Commands and since March 1962 has been command electronics officer, Far East Air Force.

Bryan R. Overton, B.Sc., M.I.E.E., has been appointed to the new post of manager of the Mitcham plant of the Mullard Radio Valve Company. He was previously head of the circuit physics and applications division of the Mullard Research Laboratories, Redhill, which he joined in 1947. Mr. Overton, who is 39 and a graduate of Birmingham

B. R. Overton

University, was with the Admiralty Signal Establishment, Haslemere, before joining the radio industry. He was awarded the Television Society's *Wireless World* premium in 1959 for his paper "Transistors in television receivers."

L. G. Cripps

Leonard G. Cripps, B.A., succeeds Mr. Overton as head of the circuit physics and applications division of the Mullard Research Laboratories which he joined in 1954 to do research on transistors. Mr. Cripps, who is 34, obtained his B.A., degree in mathematics and natural sciences at Trinity College, Cambridge, where he did a year's post-graduate reading in electrical engineering.

R. R. Thompson, B.Sc., A.M.I.E.E., who has been with the English Electric Valve Company for seven years leading a research team designing microwave tubes, has been appointed assistant manager in charge of the Display Tubes Department. After graduating at St. John's College, Cambridge, he taught physics at Worksop College and Cranleigh School before entering the electronics industry.

R. M. A. Jones, a director of Pye Ltd. and managing director of E. K. Cole Ltd. since 1962, has been elected to the board of Pye of Cambridge Ltd., the holding company of the Pye-Ekco Group. **J. O. Stanley,** M.A., son of the chairman of the Pye Group of companies, has also been appointed a director of the holding company on the resignation of **E. J. W. Stanley,** M.A., B.Sc. (Eng.), on reaching retirement age.

Two appointments are announced by the Cossor Communications Company. **J. W. Mordin,** who joined the company a few months ago, has become general sales manager (marine products). After service both in the Royal Navy and Merchant Navy he was with Decca Radar and A.E.I. **R. R. Roper** has joined Cossor as general sales manager (communications). He was at one time with the Post Office and has since been with S.T.C. as a development engineer, the Telephone Manufacturing Company and latterly Solartron.

OUR AUTHORS

G. P. Hobbs, B.A., Grad.I.E.E., who writes in this issue on tape recording amplifiers, read physics at Christ Church, Oxford, and obtained a second class honours degree in 1961. Since then he has been working on the design of transistor equipment in Marconi's closed-circuit television division at Chelmsford.

W. V. Richings, Assoc.I.E.E., A.M.Brit.I.R.E., chief engineer of Dawe Instruments Ltd., writes in this issue on acoustic noise measurement and analysis. He joined Dawe Instruments as a development engineer in 1945 and is particularly interested in sound and vibration measurement problems. Mr. Richings serves on the International Electrotechnical Commission's Technical Committee (29) concerned with electroacoustics and is a member of its Sound Level Meters Working Group and secretary of the Shock and Vibration Transducers Working Group.

OBITUARY

Roland John Kemp, deputy director of engineering and research of the Marconi Company, died on 22nd November at the age of 62. Mr. Kemp joined Marconi's in 1917 as a test room improver and later worked on direction finding and receiving equipment. From 1930 to the outbreak of war he was engineer-in-charge of television research. During the war he was responsible for special research at Great Baddow for the Air Ministry. In 1946 he was appointed assistant chief of research at Great Baddow and two years later became chief of research. Mr. Kemp became the deputy engineer-in-chief in 1954 and had been deputy director of engineering and research since the beginning of 1963. He was a member of the P.M.G.'s Frequency Advisory Committee and had also served on the Radio Research Board of the D.S.I.R.

S. F. Pearce, B.Sc., F.Inst.P., who had been with the Electrical Research Association for 30 years, died on the 18th November at the age of 49. Mr. Pearce received his degree from London University after joining the E.R.A. as a student apprentice in 1933. His work at the association was mainly concerned with radio interference and he served on many committees of the B.S.I., the I.E.E. and the International Special Committee on Radio Interference (C.I.S.P.R.). He was also chairman of the committee of the International Electrotechnical Commission concerned with interference in ships.

NEWS FROM INDUSTRY

Microwave Equipment for Greece

A CONTRACT, with a value approaching £750,000, has been awarded to the General Electric Company by the Hellenic telecommunications organization for s.h.f. and u.h.f. equipment. The equipment is to be used in new microwave telephone links, the largest of which will run along the Greek west coast and provide two 2-way links between Patras in the south and the island of Corfu in the north. These links are to operate at about 6 Gc/s and will provide up to 960 telephone speech channels per link.

Two subsidiary spur-links operating at about 2 Gc/s are also to be installed. Comprehensive supervisory and engineer's "order wire" facilities are to be provided on all routes and the switching arrangements of the links are such that the systems can be expanded if required at a later date.

Plessey acquire Ducon.—The offer made by The Plessey Company on 22nd July for Ducon Industries Ltd., the largest component manufacturers in Australia, has now been accepted. Ducon came into being at about the same time as Plessey and, excluding the recently acquired United Capacitor Company Pty., operates five major subsidiaries in Australia and one in New Zealand. Ducon's main plant at Villawood, New South Wales, covers a 17½ acre site and has a total production area of 350,000 sq ft. Mr. Clifford Gittoes is chairman and managing director of Ducon Industries Ltd.

Environmental Testing. — The Belling-Lee laboratories have now been approved as a Class III Test House under Air Ministry and War Office approval, and are able to undertake full type-approval testing of components to D.E.F. Specification requirements. Enquiries to Belling & Lee Ltd., of Great Cambridge Road, Enfield, Middlesex, will be welcomed for approval testing, and other type testing and specialized measurements on materials, components, and apparatus.

Marconi's £4M Army Order.— The latest of three military contracts received by the Marconi Company for h.f. mobile and static communication stations, known in the Army as the S.R. D11/R234, amounts to £1,750,000. The combined value of the three contracts now exceeds £4,250,000 and the equipment supplied under the first two contracts is now in use in many parts of the world. A feature of the equipment is that the 350-watt 2-22 Mc/s transmitter and complementary receiver can be set to any operating frequency by decade controls and does not need netting with the rest of the stations in the network.

A Decca airfield control radar, Type 424 Mark II, providing facilities for final approach surveillance, has been installed at Woolsington, the North East Regional municipal airport near Newcastle-upon-Tyne. It is remotely controlled from the display position in the control tower and can be brought into use at very short notice when necessary. The radar incorporates an advanced variable polarization system for overcoming interference caused by adverse weather conditions.

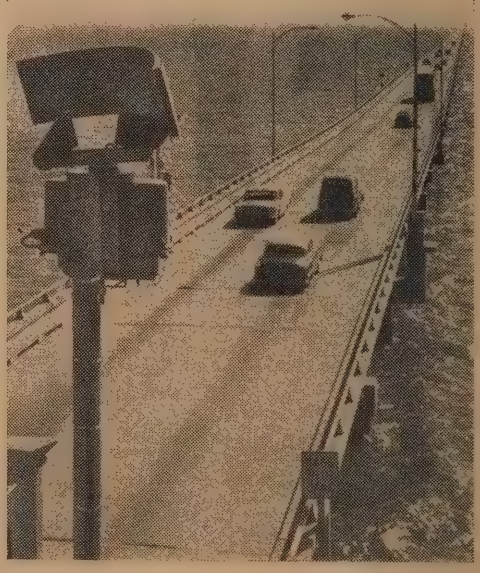
Tannoy (Ireland) Ltd. has been formed to expand and develop the range of Tannoy products and services now available in Ireland through their agents Sound Systems Ltd. It will merge with and absorb the division of Sound Systems Limited, of Upper Liffey Street, Dublin, concerned with Tannoy products, and, for the time being, operate from the same address.

The group profit after taxation of **Robinson Rentals (Holdings) Ltd.,** of which E. K. Cole is chairman, for the year ended 30th September totalled £424,920. This represents an increase of £120,585 on the previous year's results. This year's depreciation of rental assets took £1,234,306 of the £1,909,841 group profits.

Profits for the year ended 31st August of **Dictograph Telephones Ltd.,** of which Grampian Reproducers is the subsidiary, totalled £201,953; after deducting £148,991 for taxation. This year's profits represent an increase of £13,865 on the previous year's figure.

Elliott-Automation has formed a new management company, **Elliott Space and Weapon Automation Ltd.,** with headquarters at Frimley, Surrey, to co-ordinate the activities of the Group in these fields. The company has a number of projects connected with satellite development and contracts for the development of integrated weapon control systems, instrumentation and associated simulators. Elliott-Automation's work on lasers is being carried out in the new company's research laboratory. The directors of the new company are Commander H. Pasley-Tyler (chairman), W. R. Thomas, J. de M. Baynham, D. Hunter and H. Surtees.

BSR Ltd. has acquired a 180,000 sq ft factory at East Kilbride in Scotland for the manufacture of telephone and other electronic equipment.



A ship's type radar—scanner shown in the foreground—and a radiotelephone system are being used to monitor marine traffic in the vicinity of the 24-mile-long Lake Pontcharlrain Causeway and to warn craft in danger of colliding with the piers. This is the longest overwater highway bridge in the world and connects metropolitan New Orleans with the major highways serving the southern cities. Raytheon equipment is used throughout.

The recently completed Trinity House Lightship No. 20 has been fitted with radio beacon equipment designed and manufactured by **Redifon Ltd.** The installation consists of two 80-watt transmitters, together with failure alarm units, twin chronometers and code senders, and a beacon control unit. The output power of the transmitters can be altered to suit the requirements of any beacon chain in which the station is to operate and immediate indication is given of any failure of transmission. Special code discs are used in the code senders to enable the callsign and other characteristics of beacon transmission to be changed in a few minutes. Inter-ship and ship-to-shore communication is provided by Redifon GR161B 15/20-watt transistor radiotelephones. A similar installation is to be fitted to a second vessel now being built.

A technique of producing foil heating and resistance elements by a combination of foil thickness and area has been developed by **Mills and Rockleys (Electronics) Ltd.,** Swan Lane, Coventry. It is claimed that this not only solves many problems of circuit geometry but also permits variation of heating effect over the area.

High Definition Films Ltd., which was formed by Pye in 1956 to specialize in the design and manufacture of schools radio and electronic equipment, will be known in future as **Pye H.D.T. Ltd.** Its present interests also include the application of closed-circuit television to teaching, and the design and production of high-quality language laboratory equipment. B. E. Briggs is chief engineer, B. V. Soames-Charlton general manager and J. H. Jebb sales manager.

E.E.V. klystrons for BBC-2.— The B.B.C. has placed an order with the English Electric Valve Company, for a large number of 25 KW amplifier klystrons for the television transmitters now being manufactured for Bands IV and V.

Mervyn Instruments Ltd., formerly of Woking, have moved to The Hyde, Brighton 7, Sussex. Their new telephone number is Brighton 66271.

Ad Auriema Ltd., of Empire House, Chiswick High Road, have moved to Impectron House, 125 Gunnersbury Lane, Acton, London, W.3. (Tel.: ACOrn 8765.)

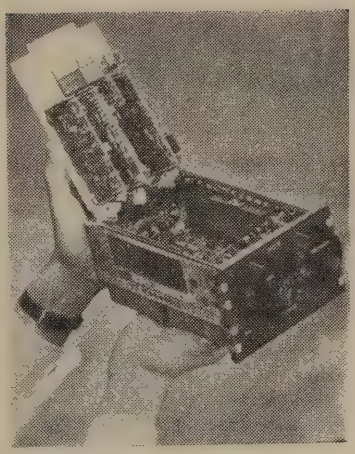
Alma Components Ltd., the manufacturers of precision resistors, have closed their London sales office and are now operating from their premises in Park Road, Diss, Norfolk. The sales office number is Diss 2287.

An **electronic reading automaton,** which reads cash register tally rolls at high speed, has been installed in the premises of Montague Burton Ltd., of Leeds, by the Solartron Electronic Group. This machine uses a video scanning technique to transfer the information from the tally rolls into punched cards and is claimed to be the first machine reading conventional printed digits optically to come into full commercial operation in Europe.

Crosfield Electronics Ltd. have placed an order with **Rank Cintel** for 25,000 9in high-resolution cathode-ray tubes. These tubes are to be used in Crosfield "Scanatron" equipment designed for automatically correcting colour and tonal distortions in photographic separations for process colour printing.

British Telemeter Home Viewing Ltd. is not a subsidiary of International Telemeter as stated on page 607 of our last issue but is an independent British company set up to "manufacture and exploit Telemeter systems in this country and elsewhere."

Grundig (Great Britain) Ltd. have opened new showrooms at 15 Orchard Street, London, W.1. (Tel.: WELbeck 4898.)



One of the v.h.f. airborne communication equipments Standard Telephones and Cables are to supply to the Army and R.A.F. under a recent contract valued at approximately £100,000. This equipment uses transistors throughout, with the exception of two valves in the p.a. stages, and with 50kc/s channel spacing, covers the frequency range 116.0 to 135.95 Mc/s.

Hewlett-Packard Ltd., of Dallas Road, Bedford, are taking over an adjoining factory to increase their production floor area.

NEW AGENTS

The **English Electric Valve Company** has appointed Leon Kouyoumdjian of Sa'addon Street, Aliwiya, Baghdad, as the exclusive agent for Iraq.

Impectron Ltd., the U.K. agents for **Sennheiser Electronics,** of west Germany, have moved to Impectron House, 125 Gunnersbury Lane, Acton, London, W.3.

Southern Instruments, of Camberley, Surrey, have been appointed U.K. agents for **Kistler Instruments Ltd.** of Winterthur, Switzerland. The products they are to handle will include pressure, acceleration and load transducers, and associated amplifiers.

Wayne Kerr Laboratories Ltd., of New Malden, Surrey, have signed a new licensing agreement with the **United Systems Corporation,** of Ohio, U.S.A. It provides for the marketing—and the eventual manufacture—of the U.S.C. Digitec range of digital voltmeters by Wayne Kerr in the United Kingdom.

Silicon Transistor Corporation, of America, have appointed Walmore Electronics Ltd., of 11 Betterton Street, Drury Lane, London, W.C.2, sole U.K. agents.

Sound Systems Ltd., of 11 Upper Liffey Street, Dublin, have been appointed Eire and Northern Ireland distributors for the full range of industrial electronic metal detectors and laboratory instruments manufactured by Rank Cintel, a division of The Rank Organisation.

North Atlantic Industries Inc., of Plainview, L.I., New York, manufacturers of instruments and servo devices, have appointed Aveley Electric Ltd., of South Ockendon, Essex, as their exclusive U.K. representatives.

G.E. Industrial Supplies Ltd., of 3 Percy Street, London, W.1, have been appointed U.K. agents for **Industrial Electronic,** aerial manufacturers of Copenhagen, and the American manufacturers **Pendar Incorporated** whose products include illuminated push-button switches and indicator lamps.

AEROSPACE TELEMETRY—Some Recent Developments

IN providing an instrumentation service for "vehicles" which have usually been under intensive development and investigation, aerospace telemetry has also tended to take on something of an experimental character. However, a considerable degree of finality has now been reached with many projects, so that their telemetry requirements have become much less fluid. In turn this has meant that it has been possible to "freeze" at least some of the elements of these telemetry systems during the past few years.

As a result, standardized modular units have made their appearance on both sides of the Atlantic and, especially in the U.S., complete telemetry system packages have been produced, often associated with a particular missile or satellite programme. Furthermore manufacturers in the U.S. have been encouraged in this policy by the establishment of standards for telemetry system characteristics from as early as 1948. These standards have been revised and the present Inter-Range Instrumentation Group (I.R.I.G.) standards cover a wide variety of system arrangements.

Similar standardization has, of course, been carried out in the United Kingdom and linked with the range programmes, as for example in Australia. In general, for a number of reasons—particularly relative sizes of missiles and scales of operation—the U.K. systems are apt to be much less complex than their American counterparts.

Two illustrations of this approach can be quoted from the Sept., 1963, International Telemetering Conference in London. The first was a neat and simple solution to the problem of obtaining accurate event marking with the relatively slow speed "465" time division analogue telemetry system.

In this system multiplexing of the data signals is carried out by a 24-channel mechanical sampling switch with a nominal frame rate of 80 c/s (i.e., one 24 channel frame occupies a period of just over 10 msec). The composite multiplexed signal is applied to a sub-carrier f.m. oscillator with a range of 130-160 kc/s, which is fed in turn to the a.m. radio-frequency output stage. The preferred method which gave event marking without demanding modification of existing equipment, was based on the injection into the sub-carrier f.m. stage of a marking oscillator signal with a frequency outside the working band. This principle has been applied for single event marking by embodying it in an override technique. In this case the "event pulse" depresses the sub-carrier frequency beyond its normal band for the relatively short period of 2 msec, so that the loss of data is small. On the ground the pulse is extracted by wideband short delay networks in the receiver.

The other illustration, due to E.M.I. Electronics Ltd., was a sensitive frequency modulator for use with systems of the "465" type. Shown at the International Telemetering Exhibition in "breadboard" form, this modulator makes it possible to dispense with d.c. amplification of low level (millivolt) signals from thermocouples, strain gauges, etc., and hence to eliminate one source of drift in analogue systems. The necessary amplification still has to be provided but this is achieved at carrier frequency. The action of the modulator depends on the reactive current in a tuned circuit being zero; and this principle is applied to a reactance modulator where the variable reactance is an amplitude modulator followed by a current amplifier. The input of the amplitude modulator is fed with a sample of the oscillator current phase-shifted by 90 degrees in addition to the data signals. As a result, the oscillator frequency varies with the input signal to give the desired frequency modulation while the reactive current in the tuned circuit is kept at zero.

Another aspect of the art, discussed at the International Telemetering Conference, was that of the desirability or otherwise of having available a visual record of telemetry data. With ever-increasing numbers of measurement channels required for complex trials and investigation programmes, it becomes almost inevitable that analysis of data ceases to be carried out by visual inspection, and complete reliance is placed upon computers. However it was agreed that a graphical pilot record—the so-called "quick-look" record—provided a means of detecting physical trends and their interrelation.

Therefore there is still a demand for accurate graphical presentation of telemetry data in "real time," and in addition for instantaneous monitoring facilities for use by operational staff. Thus at the extremely large "Data Central" installed in the Goddard Space Flight Center, Greenbelt, Maryland, four cathode ray tube displays are provided for this purpose, each capable of showing up to 150 channels. These displays enable satellite system deterioration and catastrophic faults to be detected, in addition to giving checks of system operation during pre-flight testing.

The high-speed tape recorder is becoming the universal medium for data recording. One of the main problems is the maintenance of a constant tape speed to the order of accuracy required for telemetry purposes, particularly where high frequency response is involved. This is especially relevant with regard to what has become known in the U.S. as "Intrachannel Time Displacement Error." I.T.D.E. is a function of the difference between the tape speed when recording and when reproducing, and has an instantaneous and a long-term aspect. The long-term value can be reduced by several orders by servo control relative to a recorded time reference signal. This method, however, tends to increase the instantaneous error because of the inherent lag in the servo system. Clearly if the mass of the mechanical elements of the servo system can be reduced, following is improved and instantaneous I.T.D.E. is brought down.

The Sangamo Electric Company claim to have developed a system with sufficiently low following error to give practically negligible instantaneous displacement error. Values given for the higher tape speeds, where the problem is easier, are 10μsec for 30in/sec, 5μsec for 60in/sec, and 3μsec for 120in/sec. The system is based on eddy current braking of a thin copper disc, the braking current being the speed correcting error signal. The latter is derived from two error detecting sub-systems. One of these is a frequency discriminator with a centre frequency equal to that of the recorder stable crystal reference, and the other is a phase comparison bridge fed from the reproduced tape reference signal and the crystal reference. The two outputs are combined and after power amplification are fed to the winding of the braking electromagnet. R. E. Y.

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SILVERED mica capacitors in values from 10 to 2,000 pF are available from Alston Capacitors Ltd., of Diss, Norfolk. The components are epoxy-resin encapsulated and meet the DEF5132 specification to H1 humidity category from −55 to +125°C.

4WW 383 for further details

Colour Television Monitor

IN anticipation of the development of colour television broadcasting in Europe, Standard Elektrik Lorenz A.G. have developed in their Schaub-Lorenz division at Pforzheim a transistor monitoring receiver using a rectangular shadow mask tube giving a picture of 28 × 21 cm. Silicon planar transistors (BFY37 and BFY39) are used in the line timebase and the circuit is subdivided into plug-in (DIN41 490) printed circuit units performing separate functions. Front controls include the usual contrast, brightness, saturation, line and vertical hold.

4WW 384 for further details

Low-frequency Signal Generator

SINE or square wave outputs may be obtained over a frequency range of 5 c/s to 125 kc/s from the SG66 low frequency signal generator manufactured by Advance Components Ltd., Hainault, Essex. The output voltage may be read from a calibrated voltmeter. The sine wave output has an impedance of 5 or 600Ω. At the full output of 1 W, the distortion is less than 0.5%; hum and noise level is less than 0.25% of full output. The rise-time of the square wave is not greater than 0.75μsec at all frequencies.

The frequency coverage of the instrument is achieved in five ranges and the accuracy of calibration is within ±1%. The cost is £65 and a mains power supply of 100/130 or 200/260 V 40 to 60 c/s is required. The dimensions are $16\frac{1}{2} \times 10\frac{1}{2} \times 8\frac{3}{4}$ in.

4WW 385 for further details

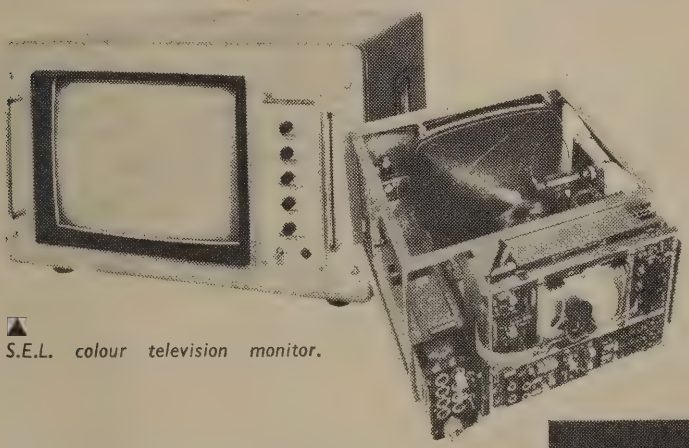
Audio Amplifier

A MINIATURE audio amplifier suitable for the audio stages of a car radio receiver, high-power domestic radio and record player is available from Newmarket Transistors Ltd., Newmarket, Suffolk. The power requirement of the amplifier, which is transformerless, is 12 V (direct). The input impedance is 1 kΩ and two versions, differing in sensitivity, are available. The PC5 requires an input signal of 50 mV r.m.s. for 3 W output, the PC5+, 5 mV for 3 W output. At this output, and with a lkc/s signal, the total distortion is 3%. The frequency response extends from 50 c/s to 15 kc/s. The amplifier operates satisfactorily over a temperature range of 0 to 45° C. Weighing only 2 oz, the dimensions are $5\frac{1}{2} \times 1\frac{3}{4} \times \frac{3}{4}$ in.

4WW 386 for further details

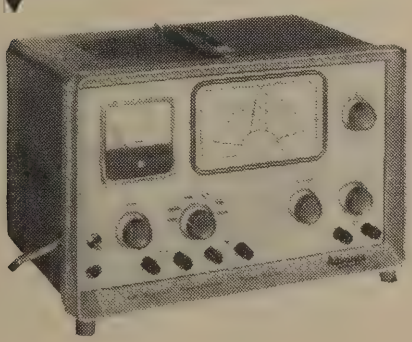
Synthetic Sapphire Components

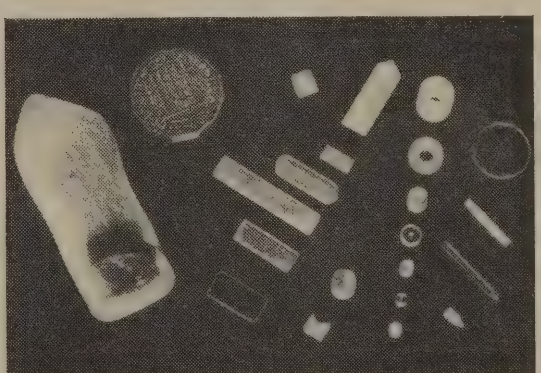
WINDOWS for optical and microwave applications are fabricated in synthetic sapphire by Agate Products Ltd. of Sutton, Surrey. Discs from



▲ *S.E.L. colour television monitor.*

Type SG66 low frequency signal generator manufactured by Advance Components. ▼





▲ *Synthetic-sapphire components manufactured by Agate Products.*

$\frac{1}{4}$ in to 2 in in diameter are available in various thicknesses—down to a possible 0.002 in with a 2-micron surface polish.

Optical transmission to 1700 angstroms in the ultra violet and 5.5 microns in the infra red makes the material particularly useful for the protection of space vehicle solar cells while the low losses, high dielectric constant and mechanical stability suggest useful applications in the microwave field.

4WW 387 for further details

Television Mains Rectifier

A SILICON rectifier, intended for use in television receivers, is available from Ferranti Ltd., Hollinwood, Lancs. Designated the Type ZS800, the diode has a maximum peak recurrent reverse voltage of 800 V and a peak transient reverse voltage of 1,350 V. The maximum recurrent peak current is 5 A, the peak surge current being 50 A maximum. The case of the rectifier is isolated from the mains. The overall length of the body is 0.48 in. The maximum diameter is 0.255 in and connection is by means of flexible leads.

4WW 388 for further details

Transistor Oscillator

THE range of S.T. and C. transmission testing apparatus has been increased by the production of a transistor oscillator covering from 10 kc/s to 20 Mc/s in 8 ranges. The instrument is powered by dry batteries housed within the case, but an external d.c. supply may easily be connected. When the lid of the oscillator is closed, a safety switch disconnects the power supply.

The output is thermistor stabilized and can be adjusted from 0 to −50 dBm into 75 Ω unbalanced circuits. By means of a transformer and "U" link the output can be fed into 140 and 600 Ω balanced circuits at frequencies up to 600 kc/s. The output monitoring meter can also be used for checking the power supplies.

Designated the Type 74306-A, the instrument weighs 15 lb and measures $16\frac{1}{4} \times 12\frac{1}{2} \times 7$ in. It can be obtained from the Transmission Systems Group, Standard Telephones and Cables Ltd., North Woolwich, London, E.16.

4WW 389 for further details

Transistor Curve Tracer

THE Transiscope TS/01 transistor curve tracer, available from A.E.S. Electronics Ltd., Theobalds Road, London, W.C.1, has a 3-in diameter display tube upon which a family of ouput characteristic curves of collector current against collector volts may be displayed. The characteristics of two transistors can be displayed simultaneously. The instrument can also be used for the measurement of β, I_{co} and collector to emitter leakage current. These values are directly indicated on a meter. The collector volts can be varied from 2 to 48 V, the maximum collector current being 1 A. β can be measured on 0-100 and 0-300 ranges of the meter. The range of base current extends from 5 μA to 5 mA. A 200/250 V alternating mains supply is required.

4WW 390 for further details

Coaxial Cable

TWO low-loss, television down-lead cables have been introduced by the Cable Division of Associated Electrical Industries Ltd., Hatton Garden, London, E.C.1. Both types have a stranded, copper wire inner conductor insulated with cellular polythene. The copper wire braid is sheathed with brown p.v.c.

Cable, Type 75/R/12 is a general purpose cable, whereas the Type 75/R/9 is intended for use in "fringe" areas. This latter variety is a larger cable with a lower loss. The nominal impedance of both cables is 75 Ω. At 200 Mc/s the attenuation in dB/100ft is 2.8 for the g.p. cable and 2.3 for the low loss type. At 800 the figures are 5.8 and 5.3 dB/100ft. The velocity ratio of both types is 0.81.

4WW 391 for further details

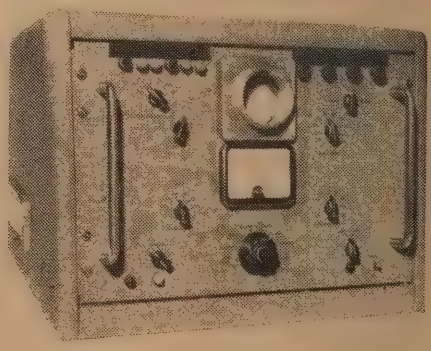
Miniature Collet Knobs

A FEATURE of the new range of miniature collet knobs developed by the Plessey Company Ltd., Titchfield, Hampshire, is that the same basic phenolic moulding can be fitted to shafts of both $\frac{1}{8}$in and $\frac{3}{16}$in diameter, using alternative collets.

▲ *S.T.C. transistor 10kc/s to 20Mc/s oscillator.*

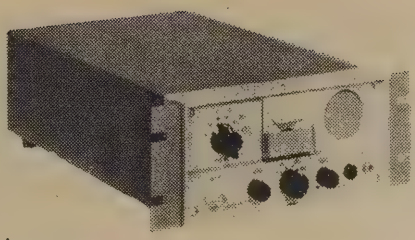
▲ *Plessey miniature collet knob.*

Transiscope TS/01 (transistor curve tracer) available from A.E.S. Electronics. ▼

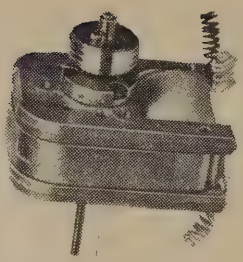


The knob assemblies require a radial groove in the shaft and a slot across its end. Tightening the locking screw contracts the collet so that it locates in the radial groove; this prevents the knob from being pulled off the spindle. The drive is transmitted by a key which engages in the slotted end of the spindle.

4WW 392 for further details



▲ *Gertsch standard- frequency receiver Model RHF-1 is available from Wayne Kerr.*



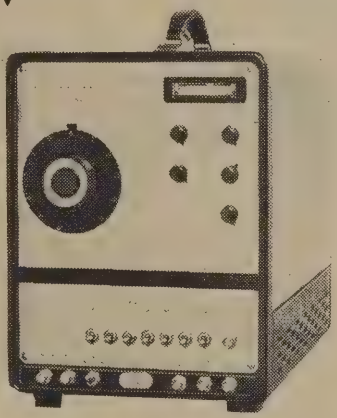
▲ *Sigma Cyclonome Model 9AB2 stepping motor. A maximum stepping rate of 400 steps per second may be attained.*

Standard-frequency Receiver

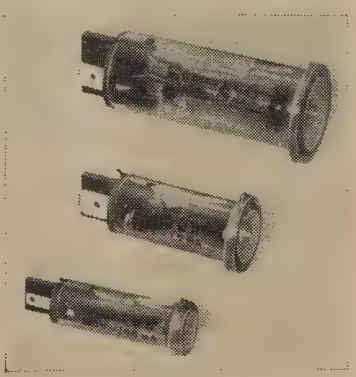
A TRANSISTOR, superheterodyne receiver of high sensitivity designed for the reception of all international standard-frequency transmissions is announced by Wayne Kerr. Applications of the Wayne Kerr-Gertsch, Model RHF-1 include precision time measurement, reception of standard audio frequencies and pulse code modulation. Output terminals are provided for oscilloscope connection. The receiver can be powered by 115/230V a.c. mains or by a 12V battery. Operating frequencies are 2.5, 5, 10, 15, 20 and 25Mc/s, but up to three frequencies between 2.5 and 25Mc/s may be added. The working sensitivity is 1μV. Normally a bench mounting receiver, it can easily be adapted for rack mounting.

4WW 393 for further details

The Telonic sweep generator Model SV-13 available from Livingston Laboratories. ▼



Cerberus neon indicator units. ▼



Stepping Motors

SINGLE-PHASE, high-torque, synchronous stepping motors designated "Cyclonome" motors are obtainable from Ad. Auriema Inc., 414 Chiswick High Road, London, W.4. Torque can be developed in 18° steps over a wide range of stepping speeds with "instant" stop and start action. Motors from the series can be driven from mains, oscillators, flip-flop circuits, relays or manual switches. A typical model of the range, the Type 9AB2, has a maximum stepping rate of 400 steps per second with damping or 50 steps per second without damping.

4WW 394 for further details

V.H.F. Sweep Generator

A FREQUENCY range of 20 to 220 Mc/s is covered by the Telonic Model SV-13 sweep generator. The instrument, which is marketed in the U.K. by Livingston Laboratories Ltd., Camden Road, London, N.W.1, was designed primarily for the alignment of television and v.h.f. equipment. Thirteen plug-in units are used to cover the frequency range; channels for American, Australian, Italian and other European television standards are available. The sweep width for r.f. stages is variable from 5 to 20 Mc/s and for the i.f. stages, variable from 10 to 40% of the centre frequency. The metered output is variable from 3.5μV to 1V r.m.s. into 75Ω. Pulse-type markers are provided at the appropriate sound and video frequency spacing. The price of the basic instrument is £280. R.f strips vary from £7 to £8 5s dependent on the frequency required.

4WW 395 for further details

Neon Indicating Units

NEON indicators from the Cerberus G.F.-range of components are available in three sizes. The units are easily mounted by a "push-fit" into a circular hole. A range of colours are available and the indicators can be supplied with either square or round fronts. Dependent on the size required, 100/130 or 200/250V versions may be obtained. The U.K. agents for these indicators are Walmore Electronics Ltd., Betterton Street, Drury Lane, London, W.C.2.

4WW 396 for further details

Instrument Trolley

WHEN it is found necessary to convey test instruments for routine testing or maintenance, the Avoncel TM2SE test instrument trolley provides many facilities. The basic trolley is constructed of heavy gauge steel and rectangular-section steel

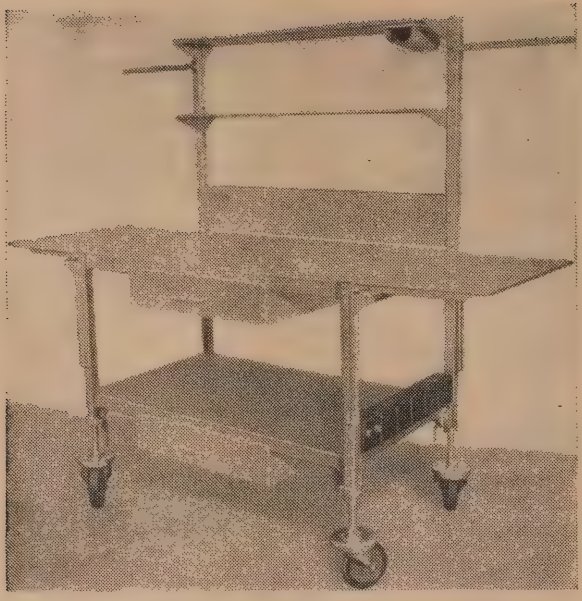
INFORMATION SERVICE FOR PROFESSIONAL READERS

To expedite requests for further information on products appearing in the editorial and advertisement pages of *Wireless World* each month, a sheet of reader service cards is included in this issue. The cards will be found between advertisement pages 32 and 35.

We invite readers to make use of these cards for all inquiries dealing with specific products. Many editorial items and all advertisements are coded with a number, prefixed by 4WW, and it is then necessary only to enter the number(s) on the card.

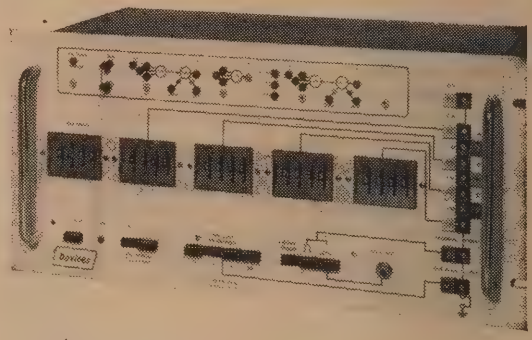
Readers will appreciate the advantage of being able to fold out the sheet of cards, enabling them to make entries while studying the editorial and advertisement pages.

Postage is free in the U.K., but cards must be stamped if posted overseas. This service will enable professional readers to obtain the additional information they require quickly and easily.



▲ *A comprehensive instrument trolley developed by Avon Communications and Electronics Ltd.*

▲ *Cathode ray tube Type T948H manufactured by the English Electric Valve Company. Two phosphors are available.*



▲ *Devices "Digitimer" (digital time marker).*

tubing welded to provide two side sections to which the top and bottom shelves are bolted. The height of the trolley may be adjusted between 30 and 36in. The main shelves constructed from $\frac{1}{8}$in steel plate, are 18in apart and the dimensions are 42×24in. The trolley runs on heavy-duty Flexello castors using ball bearing swivels. Accessories include side extension shelves, handbook rack, two supplementary shelves, drawer assembly and an asbestos-insulated electric soldering iron holder. Two of the castors are fitted with braking facilities and the trolley can carry an 800lb load. Power distribution is effected by five 3-pin sockets and 30ft of 3-core mains cable; a mains switch and neon indicator are provided. The manufacturers, Avon Communications and Electronics Ltd., Christchurch, Hampshire, can provide linoleum, rubber or Formica surfaced shelves if required. A fully equipped trolley costs £98 15s. The basic unit is approximately £60.

4WW 397 for further details

Core Stores

A RANGE of standard magnetic core stores are available from Mullard. They have been designed to meet most applications in computer, data processing and other similar fields. A series of stores with a cycle time of 2 μsec and capacities of up to 16,384 words are included in the range. Previous stores were custom manufactured, thus the new range, being manufactured on a production basis, will cost less and can be obtained quicker.

The 16D2 Series of random-access, coincident current stores is characterized by the availability of standard capacities of 16,384, 4,096 and 1,024 words of up to 50 bits each. The minimum cycle time for a read-rewrite cycle is 2 μsec and the access time is not greater than 1 μsec. The 4B6 series of random-access stores has a maximum word capacity of 4,096 words of 40 bits. The minimum cycle time is 6 μsec and the access time is not greater than 2 μsec. The stores of the 4C20 series are compatible with the range of 100 kc/s encapsulated circuit blocks marketed by Mullard Equipment Ltd. and the standard capacities available are 256, 1,024 and 4,096 words.

4WW 398 for further details

Time Interval Marker

ELECTROPHYSIOLOGICAL investigations frequently require the use of a cathode ray oscilloscope to plot the time course of the electrical activity evoked by a stimulus. To effect this, there should be provision for adjusting the repetition rate of the stimuli, a means of calibrating the time axis of the oscillograph and the possibility of triggering the oscilloscope timebase and stimulus generator at pre-determined times within the period of the experiment. The transistor "Digitimer," manufactured by Devices Ltd., Welwyn Garden City, Herts., provides all these facilities. A time scale derived from a crystal-clock pulse generator drives several ring-of-ten dividers to give time markers within the range 0.1msec to 100msec. Square waves are provided by the instrument and sufficient power is available to operate relays.

4WW 399 for further details

Delay Lines

LOW-COST delay lines for use in colour television receivers (SECAM) are being produced by C.S.F., boulevard Haussmann, Paris. Constructed from mild steel, the tolerance for the nominal delay time of the line is $\pm 0.17\mu$ sec over a temperature range of 20 to 55° C. The bandwidth of the line is 2 Mc/s, the centre frequency being 4.43 Mc/s. Between 3.4 and 5.4 Mc/s the attenuation reaches a maximum of 24 dB. The transducers at either end of the line are lead-titanate piezoelectric ceramics, the thickness being such that the frequency of the shear wave used for transferring the signal corresponds to a frequency of 4.43 Mc/s. The overall dimensions are 22×1.7×1.7 cm. The weight is 235 gm.

4WW 400 for further details

Cathode Ray Tube

A 5-in cathode ray tube has been developed by the English Electric Valve Company for use in wide-band, high-speed oscilloscopes. The

deflection sensitivities in x and y directions are 3 and 9 V/cm respectively. The p.d.a. mesh is positioned a few millimeters from the phosphor screen. This reduces raster distortion and improves the stability of the x and y deflection sensitivities to changes in temperature. Two phosphors are available; the type T948H tube has a blue green afterglow (equivalent to P31), the Type T948N version is characterized by a yellowish green afterglow (equivalent to P2). Both versions have medium short persistance. The tubes are manufactured by the English Electric Valve Company Ltd., Chelmsford, Essex.

4WW 401 for further details

Porcelain Capacitors

SUITABLE for high-voltage, large-current radio frequency applications, Vitramon Laboratories of Harmondsworth, Middlesex, present their first "all-British" component. These are comparatively small porcelain capacitors designed to pass currents of up to 60A at 2000V r.m.s. in the frequency range 2 to 30 Mc/s. The preferred working temperature range is −40 to +100°C; the maximum temperature, however, is +150°C. Standard values ranging from 250 to 2,000pF, are available but others can be produced to special order. The power factor is quoted as being less than 0.002 at 1 Mc/s (125°C). The dielectric strength is 4,000 V d.c. (at 25°C for 10 sec.).

4WW 402 for further details

Phase-comparison Receiver

PRECISION oscillators may be standardized against v.h.f. standard-frequency transmissions with the Wayne Kerr—Gertsch, transistor v.h.f. phase comparison receiver Model PCR-1. The instrument is intended for use with local frequency standards accurate to 1 part in 10^7 or better. It has a built-in, strip-chart recorder and a two-speed, phase-locking servo system providing a very narrow effective bandwidth. Four transmissions can be switch selected within the frequency range 10 to 100 kc/s. The PCR-1 operates to a sensitivity of 0.1 μV into 50 Ω for stable, phase-locked tracking. Measuring 19in × 7in × 14in, the receiver can be obtained from The Wayne Kerr Laboratories Ltd., New Malden, Surrey.

4WW 403 for further details

Television Monitor

A NEW range of television receivers have been introduced recently by Rank-Bush Murphy Electronics, Welwyn Garden City, Herts. The precision, television monitor MR752 from this range is a 14-in, 405, 525 and 625 line monitor designed for 19-in rack mounting, but can also be obtained as a free-standing version. The receiver can adapt itself to the scanning standard of the incoming signal without manual adjustments. Variations include receivers for u.h.f. or v.h.f./u.h.f. sound and vision reception and receivers suitable for reception of N.T.S.C. colour signals.

4WW 404 for further details

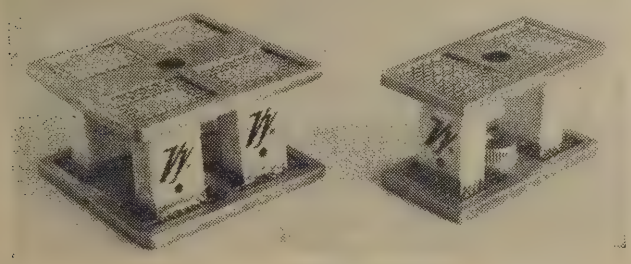
Tunable Filter

THE Allison Laboratories Model 2A tunable filter is a passive network device with independent high cut-off and low cut-off sections. The maximum passband is 15 c/s to 10 kc/s or, if the high cut-off section only is used, from z.f. to 10 kc/s. The maximum input is 1 V r.m.s. and both input and output impedances are 600 Ω. The insertion loss does not exceed 2 dB and the attenuation rate is 30 dB/octave. Cabinet and rack mounting versions are available in the U.K. from Livingston Laboratories Ltd., Camden Road, London, N.W.1. The cost of the Model 2A is £206 exclusive of duty.

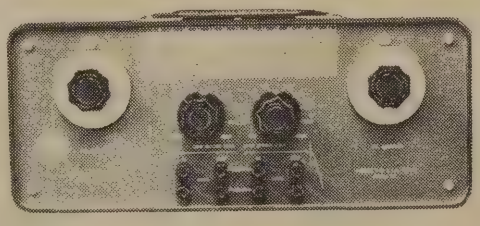
4WW 405 for further details

Audio-band Pre-amplifier

THE frequency response of the Furzehill Type P.A. 80 low noise, audio-band pre-amplifier extends

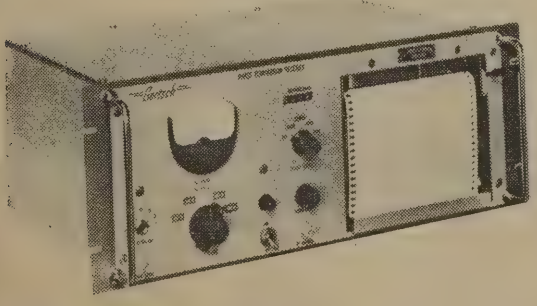


▲ *Porcelain capacitors manufactured by Vitramon Laboratories Ltd.*

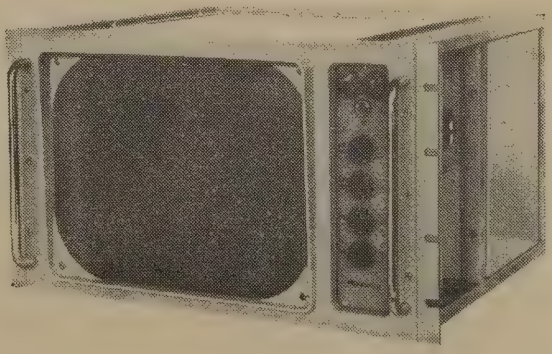


▲ *Allison Laboratories Inc. audio tunable filter Model 2A*

▼ *The 14-in television monitor Type MR752 manufactured by Rank-Bush Murphy Electronics is suitable for 405, 525 and 625 line systems.*



▲ *Wayne Kerr—Gertsch transistor v.h.f. phase comparison receiver.*



from 20c/s to 20kc/s ±1dB. The equipment is battery operated, 3 internal 4V Mallory cells providing 350 hours operating life before replacement. The voltage gain is 34dB and the signal to noise ratio is better than −6 dB at 1mV input. The harmonic distortion is less than 0.3% at 150mV input. The pre-amplifier can be operated in an ambient temperature of up to 45°C. The input impedance is greater than 30kΩ, the output being less than 100Ω. The dimensions of the instrument are $3\frac{1}{2} \times 1\frac{1}{8} \times 2\frac{1}{4}$in. The manufacturers are Furzehill Laboratories Ltd., Borehamwood, Hertfordshire.

4WW 406 for further details

Plug-in Decade

TWO inexpensive decade assemblies, suitable for incorporating into counting equipments, are announced by Panax Equipment Ltd., Redhill, Surrey. The unit, Type TD1, has scaling rates of up to 5,000 counts per second and has a resolution time of 200 μsec. The TD 2 has a maximum scaling rate of 50,000 counts per second and a 20 μsec resolution time. The decade tube in the former assembly is a Type Z504S, that in the latter is a Z505S. Both units require a 12 V power supply and driving pulses of 12 V (positive) are required.

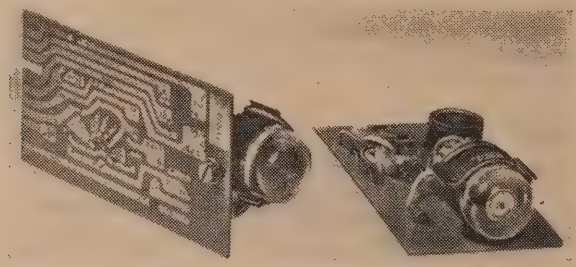
4WW 407 for further details

Transistor and Diode Tester

THE SERIES 250 Fairchild transistor, multi-parameter tester presents many interesting features. Up to 16 separate tests can be performed on a component in two seconds. Individual red lights on the front panel of the equipment indicate which of the tests the transistors fail. The tester can be programmed for routine testing and sorting and, once programmed, can be operated by unskilled personnel. The regulation of the power supply is better than 0.05 %. The transistor under test is inserted into the test head and the shield closed. The operator observes the "go/no go" conditions on the light indicators and the component can then be removed.

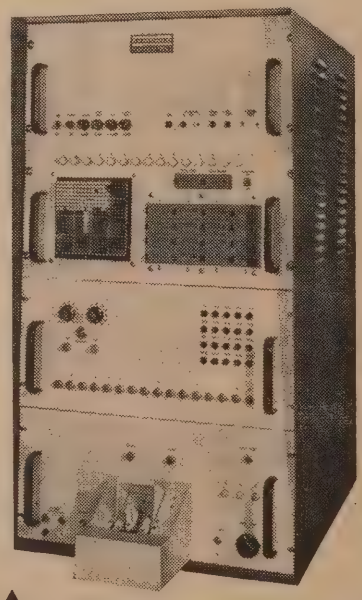
A "classification" chassis can be obtained which counts the number of times rejection of a test occurs. Counters are provided for each test, the total number of rejects and the total number of transistors tested. An additional facility enables the sixteen tests to be grouped into a classification. This consists of pass and reject combinations. Counters are provided to count the number of transistors that fall into 9 classifications (or fewer). The equipment is marketed in the U.K. by Aveley Electric Ltd., South Ockendon, Essex.

4WW 408 for further details



▲ *Plug-in decade assembly manufactured by Panax Equipment Ltd.*

▲ *Direct-reading r.f. wattmeter manufactured by Bird Electronic Corporation.*



▲ *Fairchild Series 250B semiconductor tester (distributed in the U.K. by Aveley Electric Ltd.)*

◀ *Coaxial attenuator plug introduced by A.E.I.*

R.F. Wattmeter

A WATTMETER consisting of a coaxial resistor within a finned radiator and a dual-range crystal voltmeter designated the Model 612 Termaline r.f. load wattmeter can be used over the frequency range 30 to 500 Mc/s. The power ranges are 20 and 80 W full scale with reading accuracy of ± 5% of full scale. A direct-reading instrument, it can be used for absorbing and measuring r.f. power in 50 Ω coaxial systems. The wattmeter is manufactured by the Bird Electronic Corporation and is available in the U.K. from Livingston Laboratories Ltd.

4WW 409 for further details

Coaxial Plug

A NEW coaxial plug produced by the Telecommunications Division of A.E.I. Ltd., Woolwich, enables an attenuating resistor to be wired within the body of the plug. It is envisaged that the plug will be of particular value to the hi-fi community who wish to adjust signal levels from microphones, tape recorders and pickups to a level acceptable to a common pre-amplifier.

The plug, produced in tinned brass, with an inner conductor of nickel-plated brass will, accept coaxial cables up to $\frac{3}{16}$ in diameter. Suitable for use with the existing range of A.E.I. single and multi-way coaxial sockets, the new plug has an overall diameter of 0.430 in.

4WW 410 for further details

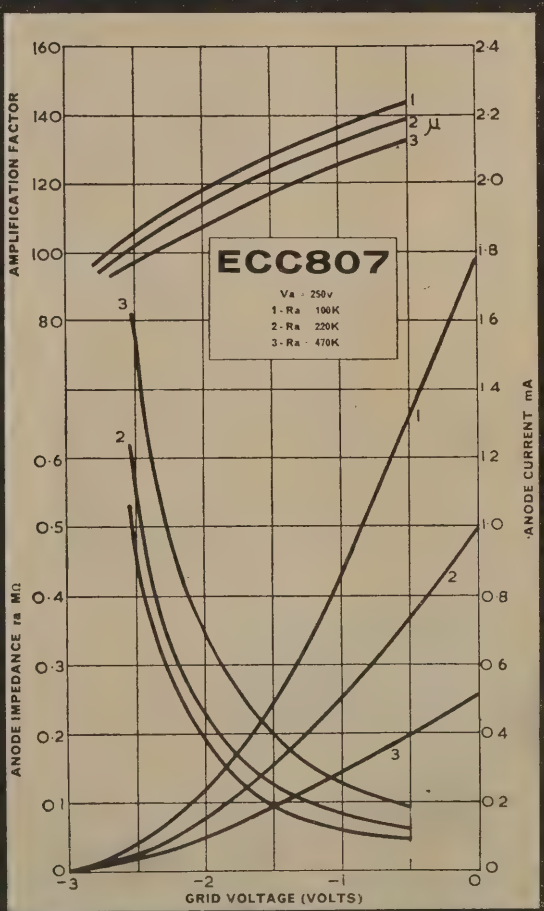
A NEW BRIMAR DOUBLE TRIODE

Particularly suitable for Tape Recorders and Instrumentation

HIGH GAIN
Amplification Factor μ140

LOW NOISE
Grid Hum Level 3μv

Better make it BRIMAR



Please ask for Data sheets

Thorn-AEI Radio Valves & Tubes Ltd.

HEAD OFFICE: 155 CHARING CROSS ROAD · LONDON, W.C.2 · Telephone: GERrard 9797

BRIMAR EXPORT DIVISION: THORN HOUSE · UPPER ST. MARTIN'S LANE · LONDON, W.C.2

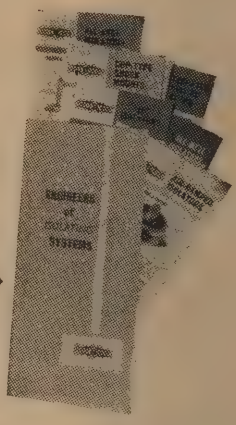
4WW—095 FOR FURTHER DETAILS.

our concern is with "Q"

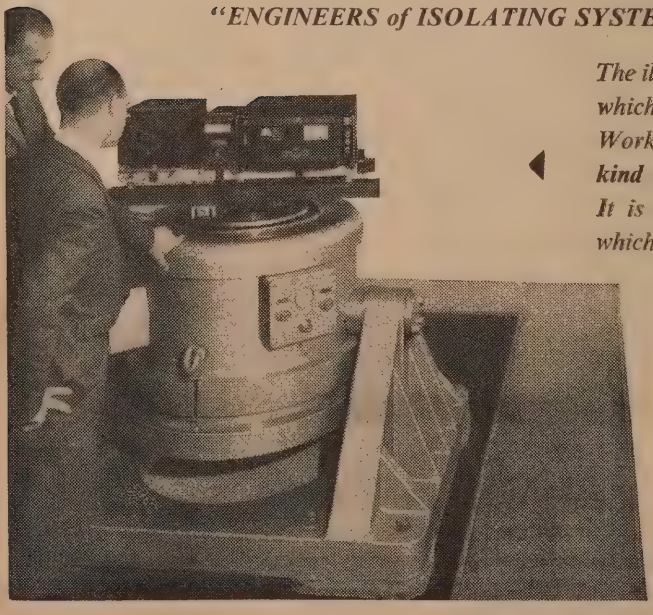
The transmissibility of a system at resonance is referred to as the "Q" of a system—a fact of which the vast majority of the readers of this Journal will be seized.

"Q" may be regarded as the measure of the efficiency with which our Isolators and Shockmounts function.

Many thousands of BARRYMOUNT Vibration and Shock Isolators are in service in aircraft on air routes all over the world. Similarly thousands of delicate instruments employed in fighting and other vehicles on land, and in ships at sea, are protected against shock and vibration by one or another of the various Isolators and Shockmounts which we design and manufacture. ***Increasingly they are being used in industry to protect modern control and recording equipment.***



Every engineer who is concerned with "Q" should have at hand a full set of these Product and Data Sheets . . . all you have to do is to write or telephone for our publication entitled "ENGINEERS of ISOLATING SYSTEMS".



The illustration (left) shows the large moving coil vibrator which is a unit of equipment in the Laboratories at our Works at Hersham; ***this is one of the largest units of its kind to be installed in an independent establishment.*** *It is typical of the resources we have developed with which we carry out environmental studies and testing.*

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BARRY B MOUNT
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THEVENIN AND NORTON

By "CATHODE RAY"

BOOKS on the principles of circuits usually contain a section on circuit theorems. Prominent among these are Thévenin's and Norton's. They are, as it were, the two sides of one coin, either of them being derivable from the other by turning it upside down; more specifically, by applying the principle of duality.

Before we get on to that I would remark that it is rather odd that both Thévenin and Norton seem to have questionable titles to these theorems. The late Prof. G. W. O. Howe pointed out* that Helmholtz anticipated Thévenin by 30 years, though he agreed later in correspondence with me that Thévenin deserves some credit for stating the theorem more clearly and giving it publicity. In the same article he also credited H. Wigge with what is generally called Norton's theorem, after E. L. Norton of the Bell Telephone Laboratories. So far I have been unable to track down any reference to a publication of this theorem by him, to compare with Wigge's.

But that is by the way. For convenience I shall here use the generally accepted names, without prejudice to any claims the ghosts of the interested parties may care to lodge. And although Thévenin's theorem was originally stated for d.c., its later extension to a.c. is assumed.

Norton's, as I said, is the dual of Thévenin's, and *vice versa;* which means that one can be derived from the other by interchanging resistance and conductance, current and voltage, and series and parallel. Thévenin's is sometimes called the equivalent series (or voltage) generator theorem, because in effect it replaces any actual source of power (a) in Fig. 1, however complicated its circuit, by an ideal constant-voltage generator in series with a single impedance Z, as in (b). The voltage E of this generator is equal to the open-circuit terminal voltage of the real generator, and the impedance is as measured at the output terminals of the real generator, with its voltage(s) reduced to zero. In Norton's theorem the replacement is an ideal current generator in parallel with the same impedance (c), the current I being that which the real generator would supply to a short-circuit.

A reader has written to say he finds some aspects of this rather puzzling. "When converting a voltage source of internal impedance Z to its current dual," he says, "how does one account for the power dissipated on open circuit when the energy is supplied by a constant-current source?"

His difficulty seems to be that removing the load Z in Fig. 1(b) interrupts the flow of current and therefore the dissipation of power in Z, whereas doing the same thing in (c) results in the full current I flowing through Z and therefore power therein is a maximum.

The answer to this particular query is simple; namely, to remember that (c) is the dual of (b), and that the dual of an open-circuit is a short-circuit. So the correct way to remove the load in (c) is to short-circuit it; this removes all current from Z, just as the open-circuit does in (b). (To carry out the dual transformation thoroughly, Z and Z_L should be replaced in (c) by Y and Y_L, the corresponding susceptances, equal to $1/Z$ and $1/Z_L$.)

Similarly, corresponding to open-circuiting Z_L in (c), which leads to maximum power loss in Z, is short-circuiting Z_L in (b), which does the same. Put another way, zero Z_L in (b) is the dual of zero Y_L in (c).

If anyone is getting worried about the possible consequences of short-circuiting Z in (c), thereby removing all visible impedance in the circuit, I would remind him that, according to the terms of the theorem, I is constant, so cannot increase without limit as he may have feared.

Are the maximum internal power losses in (b) and (c) equal? For values of Z_L in general, the values of E, I and Z must be such that (b) and (c) are exactly equivalent, at least as regards the load (which is all the equivalence claimed by Thévenin and Norton). Take the voltage across Z_L, for example:

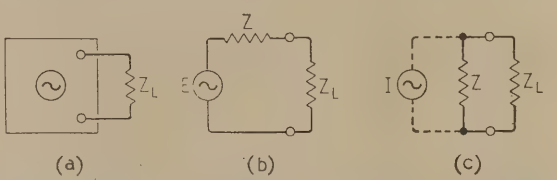


Fig. 1. A generator or signal source of any kind, feeding a load impedance Z_L, is represented by the box in (a). The alternative series and parallel "equivalent" generators are shown at (b) and (c) respectively.

$$V_L = \frac{EZ_L}{Z + Z_L} = \frac{IZZ_L}{Z + Z_L}$$

$$\therefore E = IZ$$

(Although I haven't troubled the printer to use heavy type for Z and Z_L, they are of course vector quantities and must be treated accordingly.)

Now on no-load the power loss in Z in (c) is I^2R (where R is the equivalent series resistance of Z), and in (b) is I_1^2R (where I_1 is the current). I_1 is E/Z, which we have just found to be equal to I, so the maximum amount of power dissipated in the generator's internal resistance is the same in both (b) and (c).

But is it the same in the real generator? Thévenin and Norton did not say that it was. But the Editor of *Industrial Electronics*† fears that present-day students might wonder. If so they would find it instructive to consider a numerical example; for

Wireless Engineer, July 1943, pp. 319-322.

† September 1963 p. 606.

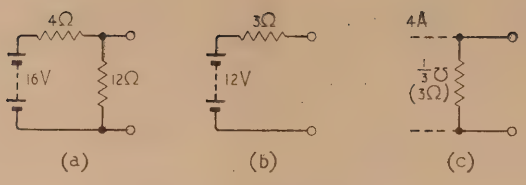


Fig. 2. Simple d.c. example of Fig. 1.

simplicity, d.c. Fig. 2(a) is the real circuit, and (b) and (c) the equivalents (so far as concerns whatever is connected to the terminals) according to Thévenin and Norton respectively. In both of them the equivalent internal resistance, which is equal to 4Ω and 12Ω in parallel, is 3Ω, though in (c) it is more correctly described as a conductance of ⅓ mho (denoted by ℧). The matching load is therefore 3Ω.

I have calculated the load power and the internal loss power in watts for all three circuits for the values of load resistance shown in the first column.

	Load				Circuit: (a)	(b)	(c)	All
	R_L ohms	$\frac{R_L}{R_0}$	G_L mhos	$\frac{G_L}{G_0}$	Internal dissipation, watts			Load watts
S/C →	0	0	∞	∞	64	48	0	0
	¾	¼	1⅓	4	46.75	30.75	1.92	7.68
	1½	½	⅔	2	37.3	21.3	5.33	10.66
Matched →	3	1	⅓	1	28	12	12	12
	6	2	⅙	½	21.33	5.33	21.3	10.66
	12	4	1/12	¼	17.92	1.92	30.75	7.68
O/C →	∞	∞	0	0	16	0	48	0

These wattages are all plotted against load resistance in Fig. 3.

The truth of our two theorems allows one output power column to serve for all three circuits. Fig. 3 illustrates the truth of another theorem—the one that says maximum output is obtained when the load resistance is equal to the internal resistance (i.e., when the load is matched to the generator.) With a.c., the load and generator impedances must be conjugates. We also see that the further statement that under matched conditions the efficiency is 50% is true, in this example, of the two equivalent circuits (internal and external power being each 12W) but is untrue for the real circuit, whose efficiency is only $12/(12 + 28) = 30\%$.

This, of course, answers our question: The equivalent generators are *not* equivalent internally. Nobody said they were, but it is nice to know.

In passing we might note that the matched condition isn't always necessarily the best. Using double the matched load resistance drops the output power by only 11% but the loss in the series equivalent is more than 55% less and the efficiency is raised to 66⅔%. With fourfold load resistance it is 80%. On the other hand, reducing the load resistance is bad both ways. The graph shows plainly that with the real generator the maximum improvement in efficiency is much less; hardly worth the reduction in output obtained by mismatching.

Closer examination reveals the interesting fact that the amount by which the power loss in the real generator exceeds that in the equivalents is constant with load resistance and is therefore equal to its no-load loss. So the loss figures for the equivalent generators indicate the *increase* in loss in the real generator due to the load. Is this a coincidence, true only of Fig. 2(a), or does it hold in general? Prof. Howe made a somewhat similar calculation* for quite a different form of circuit, with different values, and obtained the same result. With a little straightforward (if slightly voluminous) algebra one can easily prove it to be true for all generator circuits of the form shown in Fig. 2(a) regardless of resistance values. Perhaps one of our bright readers will prove it for generators in general and thereby earn the right to introduce it as a theorem under his own name.

Prof. Howe's object was to investigate an assertion by a Dr. Bernard Salzberg in the same issue, that (in relation to valve equivalent circuits at least) the series equivalent was more fundamental than the parallel. After some initial scepticism, Prof. Howe came out with some qualified support for Dr. Salzburg. He noted, as we have just done, that the series circuit gives the power supplied to the load and also the increase of internal loss due to it, and went on: "The parallel circuit gives the power supplied to the load, but not the internal loss directly; it can be obtained by modifying the load in a manner that is of little more than academic interest" (which manner he did not specify).

Perhaps the greater familiarity we have now with such sophistications as duality and normalization have made what was academic in 1947 quite practical in 1964, and Prof. Howe would have written differently now. Anyway, I am going to, by means

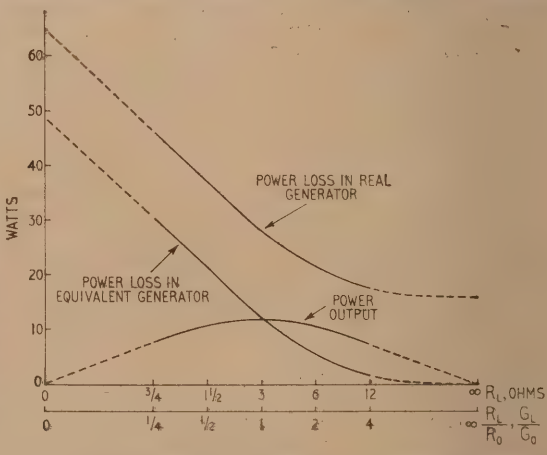


Fig. 3. Graph showing the power output of all three arrangements in Fig. 2, and the internal power loss in the real generator (a) for comparison with that in the "equivalents", (b) and (c).

of the three other columns under "Load." Nowadays we tend to give our graphs a more general application by the process called normalization. In Fig. 3, for example, the load resistance in ohms is significant only with the particular values shown in Fig. 2. The more generally significant quantity is the ratio of load resistance (R_L) to matched load resistance, which we will denote by R_0. If we rescale the load axis in R_L/R_0 values, and the power axis in ratios of actual power output to output with matched load, the graph is immediately made to apply to all series equivalent generator circuits. And if the same scale is taken to signify also G_L/G_0,

* *Wireless Engineer*, APRIL 1947, pp. 97-99.

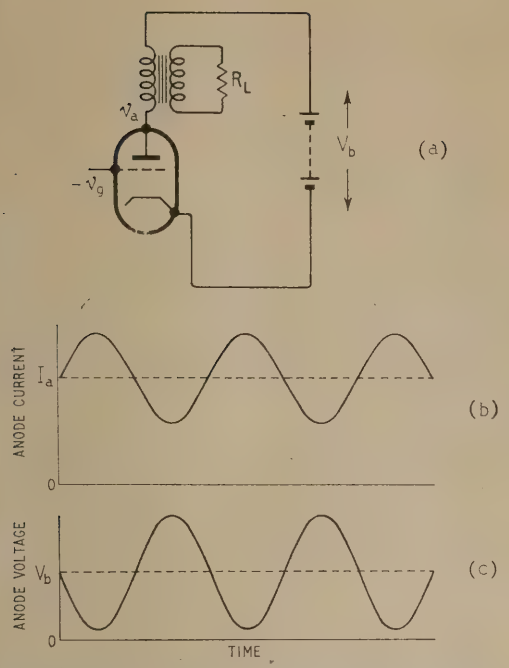


Fig. 4. The anode current and voltage of an amplifying valve (a) during a few cycles of a sinusoidal signal are shown at (b) and (c).

the ratio of conductances in the parallel circuit, the graph applies equally to it too.

To declare the series circuit more fundamental than the parallel—or *vice versa*—is, to my way of thinking, to act in contempt of the principle of duality. It is the sort of idea that Einstein effectively demolished with his relativity, by denying that any frame of reference is superior to any other. But while on the theoretical level there is no reason why one observation point should be preferred to any other, there are admittedly some sound practical reasons why we should prefer the Earth to (for example) Venus. In the matter of equivalent circuits, however, a simple modification of the load scale in Fig. 3, in full accord with contemporary practice, removes any superiority the series kind may have been able to claim in 1947.

By far the commonest use of the series and parallel equivalent generators, I would guess, is to represent valves. The fact that transistors now occupy more attention than valves is hardly likely to upset this guess, because such a representation of transistors is really too simple except perhaps at a very elementary stage. Anyway, let us consider valves. It must surely be obvious to the rawest beginner in such matters that whereas the real valve works by variations of d.c., regarded for convenience as steady d.c. with a.c. superimposed, the equivalent generators take account of the a.c. only. He could therefore hardly, at his most inattentive, imagine that the internal power loss indicated by equivalent-generator calculations could be even approximately the same as the power loss in the real valve, since most of the real loss is the d.c. part, which is there even when (above all when, actually, with Class A) the valve is supplying no a.c. output at all.

But some of the power relationships in valves and their loads are less obvious, even if again we exclude complications by taking the simplest possible case: an ideal valve (which means one whose characteristic curves are straight parallel lines; in one word, linear) driving a pure resistance load through an ideal 1 : 1 transformer in Class A (which means that the positive and negative half-cycles of anode current are equal). Fig 4(a) is the theoretical circuit diagram, and (b) shows the anode current alternating above and below its average value, I_a, during a few cycles of the signal. This anode current can therefore conveniently be considered as a steady d.c., I_a, with an a.c., i_a, superimposed. The purpose and effect of the ideal transformer is to insert the load resistance, R_L, in series with the valve for the a.c. without any loss of the steady component of anode voltage. A d.c. voltmeter (taking negligible current) would therefore show the full battery voltage, V_b, across the valve at all times. Likewise a d.c. milliammeter (having negligible impedance) would read I_a.

Now when this valve is working as indicated, the load is receiving some power. Otherwise the whole scheme would be pointless. Yet the power supplied by the battery is equal to V_bI_a whether the signal is on or off. Switching the signal on causes the load to receive power, where there was none before, yet the power supplied by the battery (which is the only source) is unchanged. Therefore, unless the laws of physics have gone haywire, the valve is receiving that much less than before. One may wonder why the presence of a.c. in the load resistance develops power there, whereas the same a.c. through the valve reduces the power there. Even when the alternations of anode voltage are plotted, as in Fig. 4(c), and are seen to be opposite in phase to i_a, the explanation may not be obvious. It looks as if decreases in anode current at any moment would be offset by simultaneous increases in anode voltage, and *vice versa*.

The simplest and quickest way of getting a clue to the problem is to suppose that the signal amplitude is sufficient to bring either anode voltage or current down to zero at its negative peak. Then clearly the power reaching the valve at such instants must be zero, notwithstanding that the other factor has been doubled. Or suppose that the peak values of i_a and v_a are equal to $I_a/2$ and $V_b/2$ respectively. At such moments the 50% drop in one factor more than counterbalances the 50% rise in the other; $1\frac{1}{2} \times \frac{1}{2} = \frac{3}{4}$, not 1.

This way of looking at it is quicker and more convincing than working it out in the orthodox manner by algebra, useful though that is for obtaining precise values, power efficiency, and so forth. It should be quite clear, too, that since V_b is constant, the alternating voltages across load and valve are opposite in phase, so that the voltage across the load

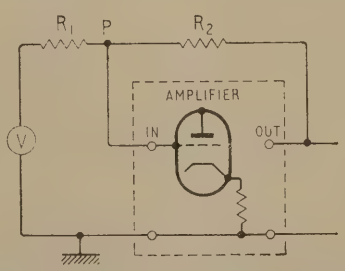


Fig. 5. Outline diagram of an amplifier with negative feedback for making the point P a "virtual earth".

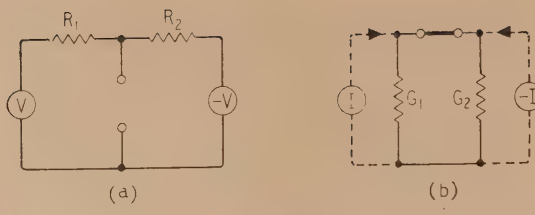


Fig. 6. The basic network of Fig. 5 is shown at (a), and when transformed into its dual is as (b).

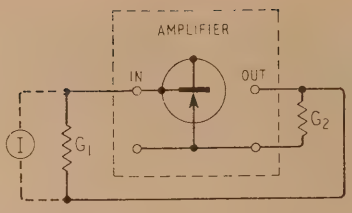


Fig. 7. Fig. 6(b) is here elaborated to show the current amplifier, for comparison with Fig. 5.

is in phase with the current there, and so means power received by the load.

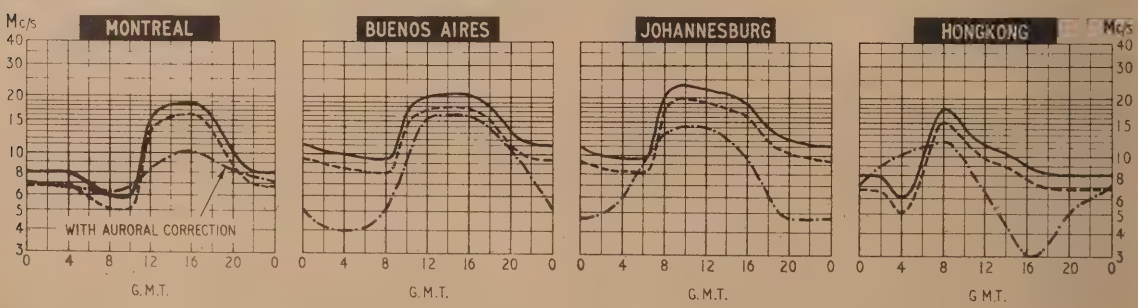
I shall finish with another question asked by my correspondent, which was new to me. He wanted to know what was the dual of a "virtual earth". Possibly he had in mind my treatise on the virtual earth in the November 1961 issue. For the information of any who may be unfamiliar with this term, it refers to the fact that the "live" input terminal of a high-gain amplifier having a large amount of negative feedback behaves almost as an earthed point, even although it may have a very high impedance to real earth. This is shown in Fig. 5, where V is a signal source. The amplifier is designed so that its output is in opposite phase to the input. Suppose its output was $-V$ volts and $R_2 = R_1$; then obviously the point P would be at zero potential and therefore indistinguishable from earth, despite the best efforts of the signal V to make it vary. This situation is of course impossible, because the amplifier would have no input to amplify for producing $-V$. But the potential at P can be made as small as one likes by making the gain large enough. A typical application of this device is an analogue computer. Subject to the small imperfection just mentioned, the current in R_1 is proportional to V. So a number of signal sources can be connected to P, each through its own resistance, and the output of the amplifier is a measure of the sum of them.

Basically, then, a voltage amplifier is used in such a way that ideally the net voltage across an open-circuit is zero. So in the dual a current amplifier must be used in such a way that ideally the net current through a short-circuit would be zero. The necessary transformation is most easily seen by drawing the essential circuit network, as in Fig. 6(a). Here we have the high-impedance amplifier input (represented by the open-circuited terminals) in parallel with a pair of voltage sources, each in series with its resistance. So the dual must consist of a low-impedance amplifier input (represented by the short-circuited terminals) in series with a pair of current sources, each in parallel with its conductance, as in Fig. 6(b).

If $G_1 = G_2$, then no current would flow between the terminals, and the current amplifier whose input terminals these are would fail to produce the current output, $-I$. So the output falls sufficiently short of $-I$ to yield a net current flow between the terminals sufficient to produce that output of nearly $-I$.

We can now translate this back into a more or less practical version by putting in the amplifier, as in Fig. 7. G_1 and G_2, like R_1 and R_2, include in themselves the conductances of the signal source and amplifier output system, but—again as with R_1 and R_2—in practice they would consist mainly of actual components of relatively high and stable value. A high conductance is, of course, a low resistance. The conductance of the amplifier between its input terminals is ideally infinite (i.e., a perfect short-circuit), just as in Fig. 5 the corresponding resistance is ideally infinite. Yet, just as in Fig. 5 the voltage across these terminals is maintained at nearly zero, so the current through the short-circuit in the dual arrangement is maintained at nearly zero.

H. F. PREDICTIONS — JANUARY



The high daytime MUFs characteristic of winter months will be maintained. The shapes of the MUF curves are similar to those of a year ago but about 5% lower. This reflects the very slow decline of the sunspot cycle.

The prediction curves show the median standard MUF, optimum traffic frequency and the lowest usable high frequency (LUF) for reception in this country. Unlike the MUF, the LUF is closely dependent upon such factors as transmitter power, aerials, local noise level and the type of modulation; it should generally be regarded with more diffidence than the MUF. The LUF curves shown are those drawn by Cable and Wireless, Ltd., for commercial telegraphy and they serve to give some idea of the period of the day for which communication can be expected.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse opinions expressed by his correspondents

B.B.C. Transmission Fidelity

FOR many years now interest in High Fidelity sound reproduction by people in all walks of life has been increasing enormously and considerable capital has been invested by enthusiasts in high-grade equipment, receivers, gramophone motors and pickups, amplifiers and loudspeakers, etc.—a tendency which to date shows no sign of abating.

During the last decade the British Broadcasting Corporation have done wonders in their planning and installation of a network of V.H.F./F.M. transmitters, which now virtually covers the whole country and is potentially capable of giving really Hi-Fi performance! At the same time they have made great strides in the output quality of their studios, with new microphones and improved magnetic tape recorders, etc., and for all these achievements they deserve our sincere congratulations.

All this is fine and listeners all over the country could —and should—by now be able to enjoy and appreciate something which we have not had so far over the length and breadth of this land, a broadcast service of really High Fidelity Sound! Whilst it is true that listeners to the B.B.C.'s London Area transmitters (F.M. and TV) *do* have such "quality" transmissions, regrettably this does *not* apply to all the many more millions, the majority, who receive their "Service" via one or the other of the B.B.C.'s provincial transmitters, because of the totally inadequate—so called—"Music Circuits" which are at present provided by the G.P.O. to interconnect such centres to London. Even the best of such land lines to the more distant transmitters have, according to what meagre information on the subject the B.B.C. have published, the very mediocre pass-band of some 8 kc/s, whilst others of pre-war vintage are still in service. One at the time of writing serves, usually alternating each six months, either the Light or Home programmes to our local Pontop Pike F.M. transmitters and handles frequencies to only some 6.5 kc/s, a standard which is inadequate to give really faithful and natural reproduction of speech, let alone music!

Nevertheless, the G.P.O. equally deserve complimenting on their achievements since they have in recent years engineered the coaxial cable and radio links which today transmit the TV picture signals embracing a bandwidth of three million cycles per second over the British Isles, soon to be increased to some five million for the new 625 line pictures. No technical or cost problem exists to using these links to additionally provide really high quality sound circuits to the transmitters, not only for the forthcoming B.B.C.2 service but all "Sound" and TV (Sound) programmes. In fact, an advertisement on page 26 of the latest issue to reach me of the "Post Office Electrical Engineers Journal" (Vol. No. 56 Part 2) offers equipment to provide "Music on TV Microwave Links—two new systems for the transmission of high-quality 15 kc/s sound channels for broadcast services." Additionally, since the B.B.C. F.M. sound broadcasting network of transmitters were engineered some eight years ago, transistorized repeater amplifiers have not only become available but have been proved in service and now offer the opportunity to up-grade many of the older cable circuits easily and cheaply.

How far out of date the B.B.C.'s present set-up of "Music Circuits" is can be realized only by bearing in mind that as far back as 1927 the G.P.O. were providing the B.B.C. with the then, so called, "simultaneous broadcasting" links to the provincial transmitters, which had a bandwidth of 10 kc/s, so we have gone backwards in this respect in the intervening years. In contrast, Germany and some other Continental countries today have networks, I understand, which transmit to a top limit of some 12 kc/s, which proves that no technical or cost problems apply—*if the will to achieve such a standard exists!*

I am sure that thousands of your readers will agree with me that it is high time the B.B.C. and G.P.O. gave this "bottle-neck" in the fidelity of present-day British broadcasting the attention it merits, so why not let us have a start made in 1964, the year in which the B.B.C.2 service is due to commence? Accordingly, I make a clarion call to all music lovers, Hi-Fi enthusiasts and ordinary listeners over the length and breadth of this country to join me in sending a postcard to the B.B.C.'s Engineering Division at Broadcasting House, London, to arrive early in the New Year, calling for "Quality" (12/15 kc/s) transmission links to all the Corporation's u.h.f. and v.h.f. transmitters to be engineered without further delay.

After all, a chain is only as strong as its weakest link, and whilst it is fine that our present day broadcast transmission chain has first-class terminal ends, we must additionally see to it that the "in between links" are equally sound and worthy of the times.

Newcastle upon Tyne. CHRISTOPHER C. V. HODGSON

The B.B.C. replies:

Your correspondent, Mr. C. C. V. Hodgson, draws attention to the desirability of making a greater bandwidth available on the line distribution network used for the B.B.C.'s V.H.F./F.M. transmissions, so that listeners who appreciate high-fidelity sound broadcasting can obtain the best possible quality.

The internationally accepted bandwidth for long-distance music lines is 10 kc/s. Most of the G.P.O. circuits linking B.B.C. studio centres and transmitters reach this standard, or very nearly, having a bandwidth of 9 or 10 kc/s. In a few cases lines are still in use with a bandwidth of 7.5 or 8 kc/s, but these are being improved as more 10-kc/s circuits become available. The lines for distributing the sound component of B.B.C.-2 will also, in general, go up to 10 kc/s.

It is true, as Mr. Hodgson says, that there is no *technical* reason why the bandwidth of all these circuits could not be increased to 15 kc/s. No doubt the G.P.O. could, in the course of time, upgrade all the circuits to this standard, but at a substantial additional cost to the B.B.C. in line rentals. This cost could be met only by reducing expenditure elsewhere. We believe we can do the greatest good to the greatest number by extending the coverage to people who are still without any television or V.H.F. sound services at all rather than by making an improvement in sound quality that could be appreciated only by a minority, though an important minority, of listeners and viewers.

Mr. Hodgson raises a particular point about the bandwidth of the lines to the Pontop Pike V.H.F./F.M. transmitters. In fact, the line used for the Light Programme reaches just over 7.5 kc/s and this is scheduled for improvement very soon. The line used for the

Home Service has a bandwidth of 10 kc/s. There have occasionally been short periods during fault conditions when the normal bandwidth may not have been maintained, but the lines are not regularly interchanged as Mr. Hodgson suggests.

London, W.1. L. W. TURNER
Head of Engineering Information Department, British Broadcasting Corporation.

Colour Television Systems

FROM Mr. Cox's excellent article on PAL (December 1963 issue) it may be inferred that colour phase alternation at field rate produces such a flicker problem that line rate switching is at all times preferable. It is probably worth recording that the embryonic N.T.S.C. system used field rate switching for two reasons. First, field rate switching allows complementary quadrature information to lie on adjacent lines. Secondly, the experimental evidence was that when the onset of phase distortion produced just noticeable crawling bars with line rate switching, for field rate switching the flicker was negligible. Whether this would be true for a 50-c/s field repetition is a mater for experimental investigation.

Later in the article the phase stability of the N.T.S.C. type reference burst is questioned. Mr. Cox has told me he is particularly interested in the cumulative phase errors in this burst which may be produced by black level clamp devices. Study of the B.B.C. publication "Specification of Monochrome and Colour Television Standards for 625-line Experimental Transmission", dated October 1962, does show that under conditions of limit adverse tolerances on line blanking and burst phase positions it is possible to find a true black level from between 8.5 to 9.9μsec (including a 100 nsec protection) after the time datum on the leading line synch. pulse edge.

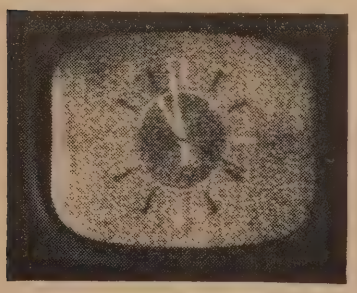
It does not appear unreasonable to perform black level setting within these time limits without the need for "soft" clamps. It would be of interest to have specific comment from those American readers of *Wireless World* who have operational experience of clamps for colour transmitters.

It is implicit in Mr. Cox's concluding argument that the disappointing growth of colour television in the U.S.A. can be attributed to the shortcomings of the N.T.S.C. system. Perhaps one should not forget that the early instrumentation for colour in the studio together with the poor brightness of the early shadow mask tubes and high cost of receivers themselves acted to limit the growth of colour broadcasting. It is possible that such equipment coupled by the SECAM signal transporting process would have made the commercial prospects for colour no better.

Hoddesdon. I. MACWHIRTER

Long-distance Reception on Band IV

I READ with interest the account of Mr. Pittam's TV-DX successes on Band IV in your Dec. 1963 issue (p. 617). Living only 12 miles from Wolverton I am most interested in Mr. Pittam's results.



Interval signal received at Twyford from Lopik (Holland) on Channel 27 on 28th October, 1963.

I have carried out similar experiments on Band IV and have been successful in receiving 10 west German u.h.f., 1 Dutch, 1 French and Crystal Palace Ch.33 test transmissions, also previously on Ch.34.

LIST OF U.H.F. STATIONS RECEIVED

Channel	*Station*	*Country*
21	Gottingen	W. Germany
23	?	,, ,,
24	Aachen	,, ,,
31	Koblenz	,, ,,
31	Baden-Baden	,, ,,
32	Saarbrucken	,, ,,
34	Feldberg	,, ,,
35	Kassel	,, ,,
37	Aachen	,, ,,
29	Dusseldorf	,, ,,
22	Paris, Eiffel Tower	France
27	Lopik	Holland
33	Crystal Palace	London
34	,,	,,

The aerial in use is a home-made 19-element array tuned to Ch.33, mounted 30ft above ground level and beamed on London.

The receiver is a G.E.C. BT311 14in fringe model modified to receive 625-line transmissions from the Continent.

I have been experimenting with DX-TV since May 1959 and to date have received 80 TV stations on Bands I, III and IV.

As Mr. Pittam says Oct. 11th was an excellent day.

Twyford. IAN C. BECKETT

Direct Voltage Trigger Circuit

I READ with interest the description of a direct voltage trigger circuit by T. K. Hemingway and J. Willis (*W.W.*, Oct. 1962, p. 460) and I had occasion recently to adapt this for use with a photo-transistor. This led to an interesting development of the original circuit which

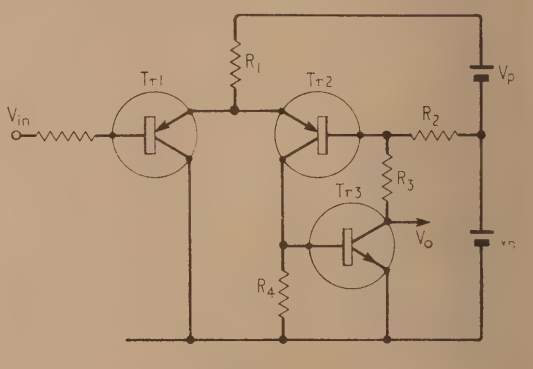


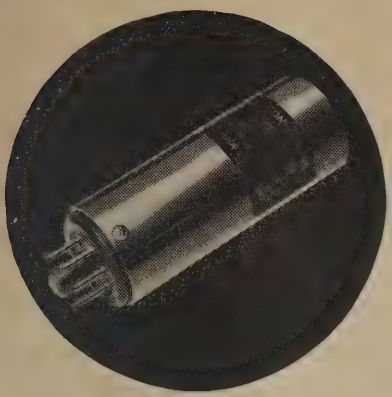
Fig. 1.

I would like to describe. First I would like to make one or two comments on the original circuit which may be of use in design of specific circuits.

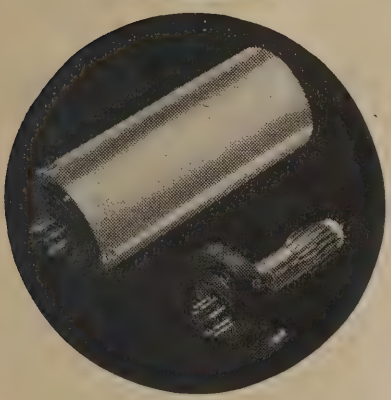
1. The appendix does not make clear to which diagram it refers for its terminology. Referring to the accompanying Fig. 1, the trigger levels are approx. zero and $\frac{V_n R_2}{R_2+R_3}$ neglecting V_{be} for both transistors. This must be taken into account if silicon transistors are used.

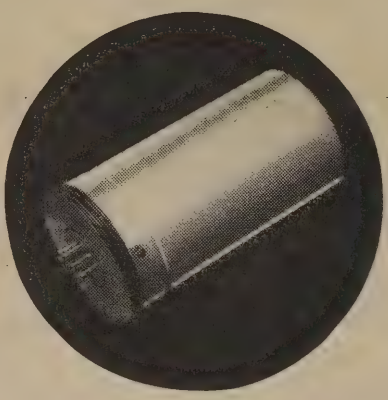
2. No mention is made of the loop gain of the comple-

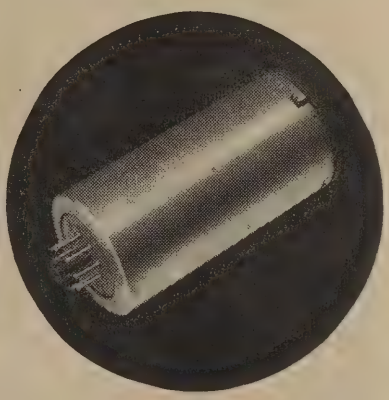
(*Continued on page 41*)



QUARTZ STABILITY



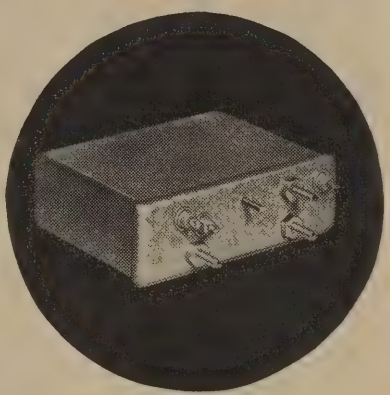




CRYSTAL OVENS

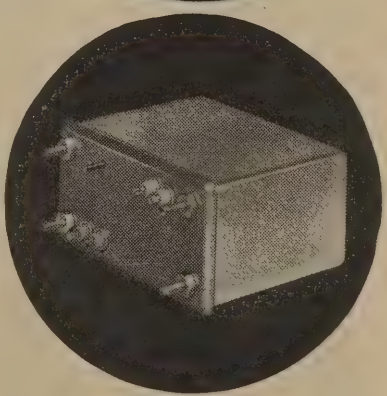
The Marconi 'change of state' oven employs no thermometer switch and has a switching differential of 0.0014°C.

Orthodox crystal ovens, using thermostats or thermometer switches, are available where wider temperature variations are acceptable.



CRYSTAL FILTERS

Standard crystal filters with SSB or bandpass characteristics are available for 100 kc/s operation, and I.F. filters for 455 kc/s. Many special filters are available for frequencies up to 20 Mc/s; and new designs can be produced to meet specific requirements.



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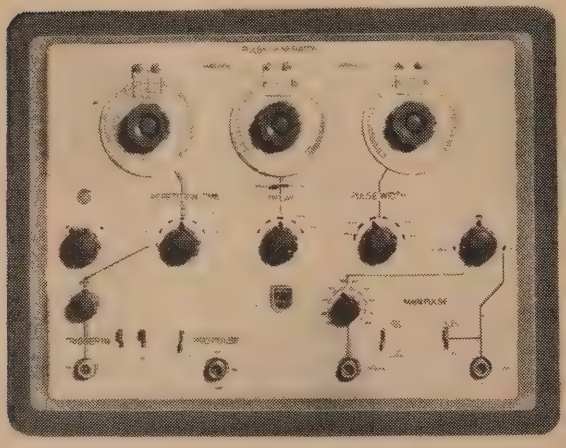
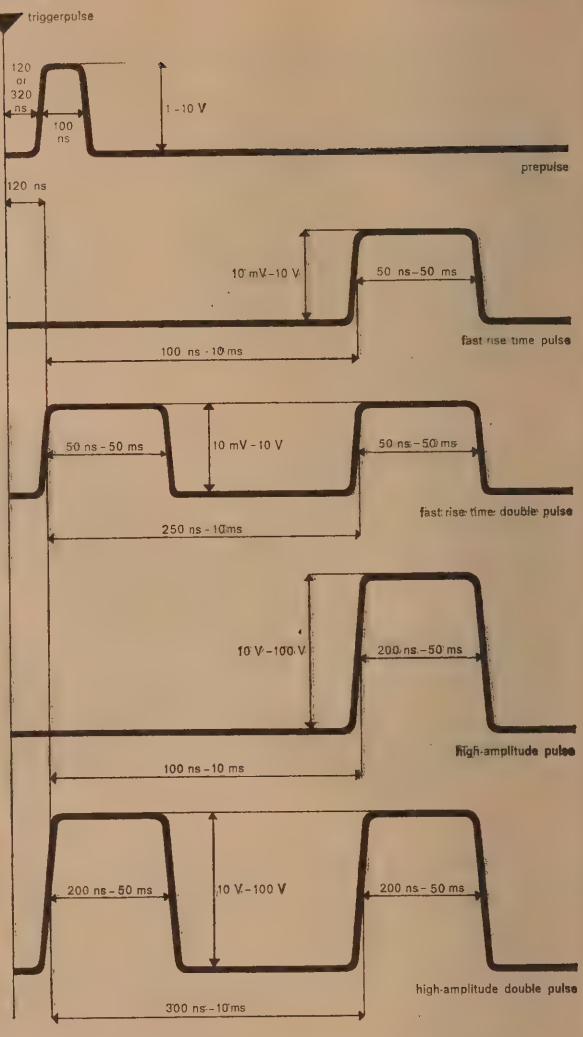
4WW—097 FOR FURTHER DETAILS.

W5C

for fast rise time and high-amplitude pulses, both as single or double pulses, with output powers up to 1.3 W




triggerpulse
120 or 320 ns
100 ns
1 - 10 V
prepulse
120 ns
10 mV - 10 V
50 ns - 50 ms
fast rise time pulse
100 ns - 10 ms
50 ns - 50 ms
10 mV - 10 V
50 ns - 50 ms
fast rise time double pulse
250 ns - 10 ms
10 V - 100 V
200 ns - 50 ms
high-amplitude pulse
100 ns - 10 ms
200 ns - 50 ms
10 V - 100 V
200 ns - 50 ms
high-amplitude double pulse
300 ns - 10 ms

DOUBLE PULSE GENERATOR TYPE PP 1122

NEW

Fast rise time pulse: polarity positive or negative; amplitude 10 mV up to 10 V; output impedance 75 Ω; rise time < 20 ns; single or double pulse.

High-amplitude pulse: polarity positive; amplitude 10 V up to 100 V; output impedance 75 Ω up to 666 Ω, dependent on output voltage; rise time < 100 ns; single or double pulse.

Pulse width: adjustable between 50 ns and 50 ms.

Pulse repetition frequency internal 10 c/s up to 1 Mc/s; external single up to 2.5 Mc/s

Prepulse: separately available; pulse width 100 ns; rise time 20 ns; amplitude 1 V up to 10 V; output impedance 75 Ω.

Delay: (of main pulse or the second of a double pulse): adjustable between 100 ns and 10 ms.

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WW—098 FOR FURTHER DETAILS

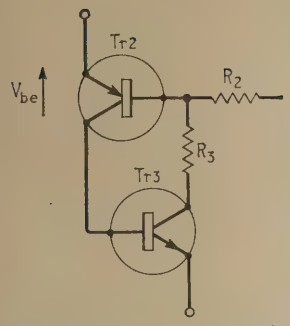

Fig. 2.

mentary pair. It is essential that this be greater than unity in order that regenerative switching will occur. Referring to Fig. 1, the loop gain is given by:—

$$G=\frac{\alpha_1\beta_1\beta_2R_2}{R_2+\beta_1R_1}$$

$$\text{or if } \beta_1\gg1,\quad G\simeq\frac{\alpha_1\beta_2R_2}{R_1}$$

ignoring the current in R_4.

The hysteresis of the circuit is given by:—

$$H=\frac{R_2V_n}{R_2+R_3}$$

since one trigger level is zero. Hence we may write H in terms of G or vice versa, viz.,

$$H=\frac{GV_n}{\alpha_1\beta_2(R_2+R_3)}\qquad \text{or } G=\frac{\alpha_1\beta_2H(R_2+R_3)}{V_nR_1}$$

The circuit is fundamently a complementary bi-stable (Fig. 2) in which the break-over potential is determined by the potential at the base of Tr2. In the above circuit this is controlled by Tr1, which to switch off the bi-stable draws current through the common emitter resistor R_1. In the modified circuit, Fig. 3, Tr1 is replaced by a photo-transistor, the collector current of which is determined by the light incident on its exposed base-emitter junction region. The base of this transistor is held at earth potential by resistor R_5, it may be preferable in some cases to return R_5 to the emitter.

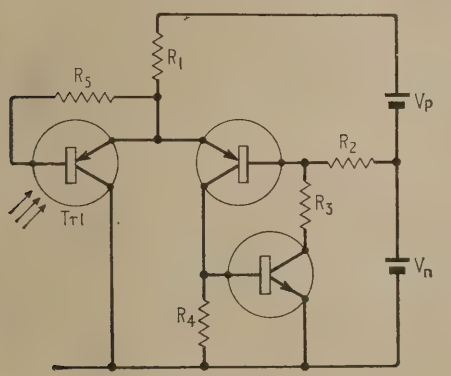

Fig. 3.

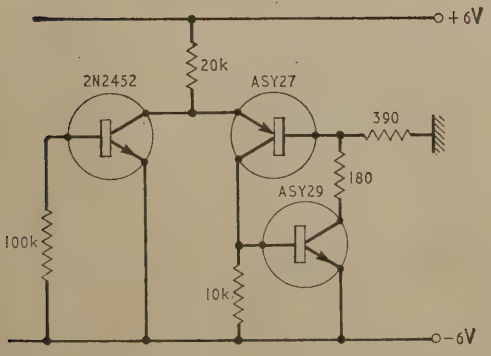

Fig. 4.

With no light on Tr1, only the dark current will flow and it is necessary that this current produces negligible volt-drop in R_1. With Tr1 illuminated current is diverted from the emitter of Tr2 and the bi-stable switches off. This current is

$$\frac{V_nR_2}{R_1(R_2+R_3)}\quad \text{approx.}$$

The circuit may be designed to operate from low light levels provided the collector current is substantially greater than the collector dark current. This may be considerably improved by using silicon transistors and photo-transistors. Alternatively a photo-diode could be used but I have not tried this version.

A typical circuit, designed on the above principles, is shown in Fig. 4.

London. H. R. HENLY,
G.P.O. Engineering Dept.

Demonstrating A.C. Theory

I REGRET to notice that the reference quoted in my letter on pp. 617-18 of the Dec. 1963 issue should have been to *Electronic Engineering* and not to *Electrical Engineering*.

I am very sorry about this, and should be grateful if you could publish a correction.

London, E.C.1. M. D. ARMITAGE

Laser Action

MAY I make a few comments on the article of Mr. Harris on lasers published in your August and September issues. This is a good review of the present state of development of optical masers but it seems that some minor corrections are necessary.

1. In Fig. 12 the energy states E_4 and E_5 of neon are regarded as metastables. But it is known that radiative transitions are forbidden for the metastables and atoms excited to the metastable state return to the normal state by dissipating energy in collisions of the second kind. Atoms can be excited to the metastables usually by falling from higher states and these metastables have a much longer life. The basic principle in He-Ne lasers is to utilize the metastable state of He atoms in causing population inversions between several Ne levels by means of excitation transfer. The He metastables are used as carriers of energy to excite the levels of Ne nearest to it. In Fig. 12 levels E_2 and E_3 should be metastables.

2. In Fig. 13 the Brewster's angle should be $(90°-\theta)$. Here Brewster's angle is the angle which the axis of the discharge tube makes with the normal to the end plate.

3. In the last few lines of page 427 it is said that total internal reflection prisms have three mutually perpendicular surfaces. But they have two mutually perpendicular surfaces. One angle is a right-angle and the other two acute angles being exactly equal.

4. In Fig. 13 the external reflectors are drawn as plane mirrors. But when using external reflectors it becomes much more convenient to use confocal plano-concave mirrors with radius of curvature equal to the separation between them. External plane mirror reflectors are very difficult to align for parallelism.

5. It has been mentioned that the active substance in a semiconductor laser must possess a large number of mobile carriers and electrons must be able to move freely between energy levels. These are not the only requirements for maser action. In germanium and silicon, carrier concentration is very large with high values of electron and hole mobilities but still these only

emit very feeble light and so far have not produced maser action. This is due to their indirect bandgap. For optical maser action the bandgap must be direct for the crystals used. Considerations of bandgap, bandshape, electron and hole mobilities, electron-hole recombination rate, traps and impurity centres, absorption coefficient, quantum fluorescent efficiency, exciton formation and radiative annihilation of excitons—all these to be taken into account when choosing a suitable semiconductor material for masers. Zinc phosphor as mentioned has not yet produced maser action.

6. The power output of Ga-As laser is 10-25 mW and there is no reason to consider it as inferior to gas discharge types whose output is about 15 mW. Ga-As type is particularly superior as regards compactness and conversion efficiency which is about 10-80%, whereas in the solid-state ruby and gas discharge types it is about 1% only.

7. The device as illustrated in Fig. 17 actually uses four He-Ne gas-discharge laser tubes, one mounted on each side of a square. Mirrors are placed at the four corners of the square. These four tubes are linked to act as a single laser.

AMARNATH CHAKRAVARTY
Institute of Radiophysics & Electronics,
University of Calcutta.

SUBSCRIPTION TELEVISION

CONTRARY to the Pilkington Committee's recommendation, the Government's second White Paper on Broadcasting recommended that an experiment in subscription television should be undertaken. Some months ago the P.M.G. therefore invited potential purveyors of a television subscription service to apply to participate in a series of tests. A large number of applications were made. Some were prepared to provide the programmes, some a subscription system, others a means of transmission (wire or radio), while others were "consortia" prepared to provide a *service*.

The P.M.G. has now announced the names of five organizations which will be taking part in a three-year experiment to be conducted initially in eight areas, including several London boroughs, Edinburgh, Leicester, Sheffield, the Bedford-Luton area and a centre in the North of England. The areas have been chosen to cover as wide a cross-section of the community as possible, and it is hoped the companies will start a service by the end of this year.

To reach the widest possible potential audience subscription television would have to be radiated over the air and, to give a truly balanced "fare," should be broadcast on several channels. With the limited number of channels available this is considered impracticable and, moreover, the use of radio necessitates some form of scrambling to ensure that only those who have paid can receive the programmes. However, in the "pilot scheme" cable distribution will be used.

The companies to be offered licences and the areas in which they will operate are:—

Caledonian Television.—Penicuik, near Edinburgh, with possible extension elsewhere in Scotland.

Choiceview.—Leicester, with an option later of an extension to London.

Pay-TV.—Sheffield and London (initially Westminster and Southwark).

Telemeter Programmes.—An area in the north of England and London (Merton, Morden, Mitcham and Wimbledon).

Tolvision.—Luton and Bedford (and probably some towns in Hertfordshire) and a London area.

Choiceview is a joint venture of the Rank Organisation and Rediffusion. This h.f. twin-cable system employs a "deferred payment" coin box. At the end of a programme a series of pulses (each representing 2d) is sent along the line, the cost of the programme is indicated on the coin box, and the requisite amount has to be inserted before another programme can be viewed.

The Telemeter system also employs a coin box, but this includes a small magnetic recorder which, when a programme is bought by placing the requisite amount in the coin box, records the price and details of the programme for accounting purposes. The U.K. franchise for the Telemeter system, which originated in North America, is held by British Telemeter Home Viewing Ltd., with whom Telefusion is associated.

Tolvision is also of American origin, and the U.K. franchise is held by Tolvision Ltd. Operated over a coaxial network, it employs a central billing system. Each selector box is "interrogated" by a signal from a central office and the "replies" are recorded on magnetic tape.

Pay-TV (the new title for Toll TV) is a British Relay system. A distinguishing feature is that payment is for viewing time rather than for whole programmes.

Details of the system to be used by Caledonian have not been disclosed at the time of going to press.

It should be stressed that the field trials are not being undertaken to decide which system would be chosen for a national network, but to ascertain if there is a demand for a subscription television service

OUR COVER

A slice of silicon on which a batch of planar transistors has been produced by a photo-lithographic process is magnified 150 times and displayed on a 21in television monitor at the Marconi Research Laboratories, Chelmsford, to facilitate inspection for mechanical faults. The television camera is fitted to the microscope from which the normal eyepiece has been removed.

New British Standards

THE latest in the B.S.I. series of standards for components in telecommunications and allied equipment covers fixed mica dielectric capacitors. Part 1 of the new standard, BS2132, lays down the general requirements and tests, and is available at 12s. Part 2 is being prepared and will give a list of standard sizes and ratings.

Magnetic tapes for automatic data processing are covered in BS3658. This new publication, priced at 6s, is the first in a series and a companion specification dealing with precision spools has been completed and is to be published shortly.

The standard for silk- or rayon-covered copper wire, BS2480, is being replaced by two new specifications as the type of rayon specified is no longer available. A standard relating to silk only—with no changes to the technical requirements—is available as BS3684 and a standard for rayon-covered wire is being prepared. The silk only specification is available in two parts—published separately at 7s 6d each—the first giving gauge dimensions in British units and Part 3 in metric units.

An addition has been made to BS488, which deals with electronic-valve bases, caps and holders. The addition, published separately at 3s, covers the B9A/D base.

Copies of the above standards are available from the B.S.I. Sales Branch, 2 Park Street, London, W.1. An additional charge is made for postage to non-subscribers.

PARAMETRIC FREQUENCY DIVIDERS

SINUSOIDAL OUTPUT WITH FAIL-SAFE OPERATION

By F. BUTLER, O.B.E., B.Sc., M.I.E.E., M.Brit.I.R.E.

TO understand this development it is necessary to have some idea of the principle of operation of a parametric amplifier. Broadly speaking, such an amplifier takes in energy at one frequency and by reactance changes uses it to obtain power gain at another frequency. The two frequencies need not be harmonically or sub-harmonically related to each other, though in its simplest possible form a parametric amplifier provides gain at a given frequency by taking power from an oscillator working at twice this frequency. If the power supplied from the pump oscillator is small in relation to the losses of the tuned circuit to which it is coupled, the effect is merely to reduce these losses or to reduce the decrement of the circuit. Higher power will result in stable power gain while excessive drive power will produce sustained oscillations at half the drive-oscillator frequency. This action amounts to frequency division by a factor of two and is used in the circuits to be described.

A characteristic feature of parametric amplifiers is the use of variable reactance in the primary tuned circuit. An iron-cored coil is an example of a non-linear inductance. A reverse-biased semiconductor diode acts like a variable capacitance, the value of which depends on the bias voltage. The collector-base diode of a transistor falls into this category and there are other examples which will be discussed later in this paper.

Principle of Parametric Amplification

Fig. 1(a) shows a lossy tuned circuit LCR in which damped oscillations can be produced by switching a charged capacitor across an inductance L of resistance R. The rate of decay of the oscillations depends on the Q-factor of the coil. In Fig. 1(b) we have a similar arrangement but with provision for varying C at strategic points in the cycle of operations. For simplicity it may be supposed that C is varied mechanically by altering the separation of its plates. If a change Q is placed on a capacitor C the voltage across its plates is given by $V=Q/C$. The stored energy is $\frac{1}{2}CV^2$. If C is made smaller, e.g. by separating the plates, then V must become larger since Q remains unchanged. If C_1 is the new capacitance and V_1 the new potential, $V_1 = Q/C_1$ and the new energy is $\frac{1}{2}C_1V_1^2$. If $C_1 = C/2$ then $V_1 = 2V$ so that the new energy is $\frac{1}{2}\frac{C}{2}(2V)^2 = CV^2$. This is exactly twice the original energy. The excess energy comes from the mechanical work done in separating the plates against the force of attraction between them.

Imagine now that C in Fig. 1(b) is charged and connected to the coil. This starts a train of damped oscillations. After one-quarter of a cycle, suppose that the plates of C are pulled suddenly apart, causing a reduction of capacitance. There is a corresponding sudden increase of potential, shown as a step at the crest of the voltage waveform, and a supply of extra energy resulting from the mechanical work which has been done. After another quarter of a cycle, the capacitor voltage sinks to zero. At this instant we restore the capacitance to its original value C but, because of the momentary absence of charge on C (or potential across its plates), we recover none of the energy previously used in separating the plates. One more quarter-cycle is allowed to elapse, after which the capacitor is charged to its peak negative voltage and once more we separate the plates. Another step is produced in the waveform and more mechanical energy is converted into electrical form. Finally, the oscillation is allowed to complete its cycle and the capacitance once more reverts to the value of C with no return of energy to the driving source.

By supplying energy in pulses at twice the natural frequency of oscillation the circuit losses may be reduced, cancelled or over-compensated. In the last case sustained oscillations will occur at the first sub-harmonic of the driving pulse frequency.

There is no need to vary C mechanically. A voltage-variable capacitor driven at frequency $2f$ can generate oscillations of frequency f. Needless, to say, a variation of L, if it could be accomplished, would serve just as well as varying C.

The simplest possible practical embodiment of

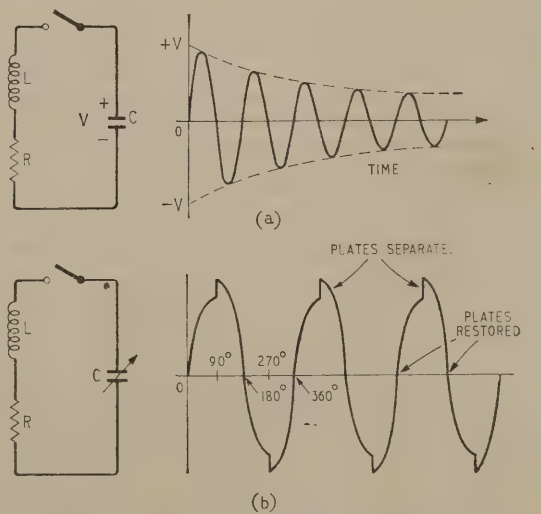

Fig. 1. Principle of parametric amplification.

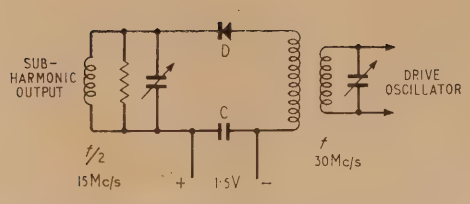

Fig. 2. Regenerative divider due to O. Nourse.

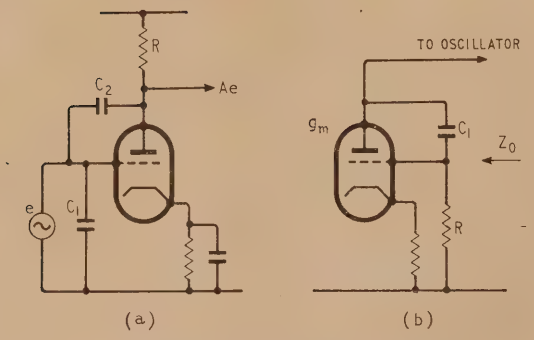

Fig. 3. Circuits giving capacitance multiplication.

Fig. 1 has been described by O. Nourse in a D.S.I.R. Report.[1] It is shown in Fig. 2. In this, D is a reverse-biased junction diode or Varicap device. The drive oscillator swings its capacitance above and below the mean value at 30 Mc/s and generates an exact sub-harmonic at 15 Mc/s in the other tuned circuit. Varicaps are normally of quite small capacitance and are thus well suited for working at very high frequencies where division by other means is fairly difficult to achieve. They are less suitable for low-frequency use.

Nourse shows that to sustain oscillations at the sub-harmonic frequency requires a fractional swing of capacitance of 8/Q where Q is the quality-factor of the tuned circuit.

Alternatives to Varicap Diodes

One of the simplest ways of obtaining the equivalent of a large variable capacitance is to connect a small one between the input and output terminals of a phase-reversing amplifier of high gain. The well-known Miller effect in triode amplifiers is one example. Another, related quite closely to the Miller circuit, is the reactance modulator which is used to provide a variable reactance across an oscillator circuit in order to swing its frequency. Both circuits are shown in Fig. 3.

It is shown in standard textbooks that the input capacitance of the Miller stage is $C=C_1+(1+A)C_2$ where C_1 is the grid-cathode capacitance, C_2 the anode-grid capacitance and A is the voltage-amplification or stage gain. If the load resistance is small compared with the valve anode slope-resistance and if C_1 is negligible, the input capacitance is simply $C=(1+g_mR)C_2$. If $g_mR \gg 1$, $C=g_mR\,C_2$.

The reactance modulator shown in Fig. 3(b) is only one of many possible circuits[2]. When it is coupled across the tuned circuit of an oscillator, the reactance connected across this tuned circuit is capacitive and is given approximately by $C=g_mR\,C_1$. The resemblance to the Miller stage is apparent.

In both cases the capacitance is a function of g_m. The dynamic mutual conductance of a triode valve is in turn a function of the grid bias so that by varying the bias, the effective capacitance C can be swung over a wide range. Even more marked effects are noticeable in transistors where the input impedance, electrode capacitances and mutual conductance all depend strongly on the base bias and on the collector voltage and current. If g_m is subjected to step-changes, or is modulated sinusoidally, there are corresponding changes of capacitance at the same frequency.

It is a simple matter to set up a frequency divider circuit to exploit this effect. Although the principle of the parametric divider has been explained by reference to step-changes in capacitance, the actual circuit works equally well with sinusoidal variations, provided of course that these have twice the frequency of the desired output from the divider.

Practical Divider Circuits

Fig. 4 shows the extreme simplicity of the parametric divider. The inductance L is tuned to the desired output frequency by a fixed capacitance C and a variable capacitance which is a function of C_1. That part of the total capacitance which is due to C_1 is modulated at the input frequency and is responsible for the parametric operation. It is convenient to set the physical size of C_1 at around 10-20 per cent. of C. Sufficient capacitance-swing can then be ensured to give reliable operation. The L/C ratio should be moderately high and it is of advantage to use a low-loss inductance. The base-bias resistance R should be set to give a reasonable standing current with no input drive; 1mA at 6V is suitable. Values of R usually lie in the range 220-680 kΩ, depending on the transistor characteristics.

The input drive current is controlled by a 10-25 kΩ variable resistance in series with a blocking capacitor.

With a low input drive current the output waveform is as shown at (a). It is a sinusoid of frequency *f*, the input frequency. Increasing the drive amplitude gives the waveform at (b). A further increase gives the desired output as at (c) which has a strong

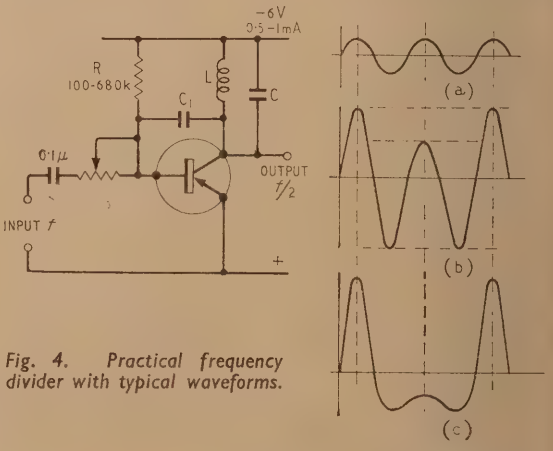

Fig. 4. Practical frequency divider with typical waveforms.

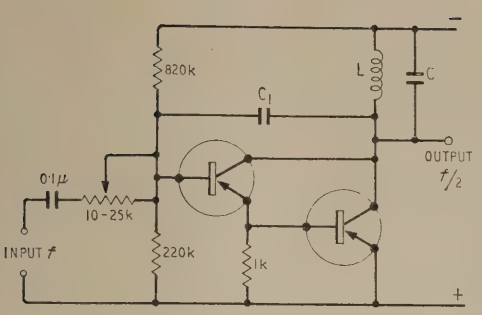

Fig. 5. Compound-connected transistors in parametric divider.

component at the frequency $f/2$. There is no output if the drive is removed.

With proper adjustment of the values of R, L, C and C_1, and with sufficient drive the operation is extremely stable and a high output is delivered at high impedance. Experiments show that division holds good over 3-to-1 changes in supply voltage and for input frequency variations of ± 20 per cent. about the tune position, but it is essential to provide adequate drive power.

Suggested component values for typical operating frequencies are given below:—

f	$f/2$	L	C	C_1
100 kc/s	50 kc/s	10 mH	820 pF	82 pF
50 kc/s	25 kc/s	20 mH	1,000 pF	56 pF
10 kc/s	5 kc/s	125 mH	0.01 μF	820 pF
1,000 c/s	500 c/s	4 H	0.02 μF	0.005 μF
300 c/s	150 c/s	4 H	0.1 μF	0.02 μF

The two smallest coils may be wound on ferrite pot cores; the 125-mH inductance can be assembled from miniature E-I laminations of nickel iron. The 4-H coil requires some 1600 turns of wire on a small Mu-metal toroid. Waveform distortion due to incipient saturation is noticeable at 150 c/s. It disappears when operating from a 2-V supply instead of the normal 6V.

The component values listed above have not been optimised for each case. A little development work might easily result in an improved output waveform and a reduction of the drive power requirements. A buffer amplifier is necessary if the divider is required to feed into a low-impedance load since any reduction in the tuned circuit Q-factor calls for a greater fractional capacitance swing.

Variants of the Basic Circuit

In Fig. 5, compound-connected transistors are used to give a higher current gain which allows the use of a smaller value for C_1. For use at frequencies around 100 kc/s the intrinsic collector—base capacitance of the transistor is sufficient to allow reliable frequency division without the necessity for any external capacitance[3]. An odd feature is that the circuit makes use of those properties of a transistor which are objectionable in high frequency or wide-band amplifiers.

It has already been remarked that high-Q coils are required in the simple circuit of Fig. 4. To get round this difficulty one may couple a form of Q-multiplier to the LC circuit and thus reduce the drive power requirements. Normally this extra complication is not justified since it tends to destroy the basic simplicity of the divider.

Finally, Fig. 6 gives the circuit of a quartz oscillator which can be made to give an output at half crystal frequency. It is somewhat tricky to set up, works only at relatively low frequencies and calls for the use of a high-grade crystal. It is an engineering curiosity rather than a useful practical circuit. The base bias resistance is necessarily very low so that the transistor draws a large current. To reduce dissipation, it is operated from a single dry cell. Feedback through the series-resonant crystal is taken to the transistor emitter from the centre-tap of L as in a normal oscillator. It is by no means certain that this circuit operates as a true parametric divider. It was tried out with this in mind and the difficulty is to think up any plausible alternative explanation which would account for its behaviour.

Comparisons with other Divider Circuits

Blocking oscillators, multivibrators, flip-flop (toggle) circuits and regenerative modulators are all possible alternatives to the parametric divider. The first gives a pulse output and may free-run on an unstabilised frequency if the drive fails. Multivibrators need more components, give a rectangular output waveform and also run uncontrolled if drive fails.

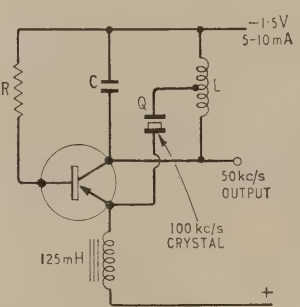

Fig. 6. Quartz oscillator giving output at half the crystal frequency.

Toggle circuits are excellent binary dividers with a fail-safe characteristic but a single stage needs two regulated power supplies, uses two transistors, four diodes, four capacitors and eight resistors. It must also be triggered by a high amplitude step-voltage, the production of which, from a sinusoidal source, calls for extra components. It is of course ideal for use in digital circuits.

We are left with the regenerative modulator. In the divide-by-two form it is simple and reliable. Fig. 7 shows a transistor version for comparison with the parametric divider of Fig. 4. The 25 mH coil tunes, with various shunt and reflected capacitances, to 50 kc/s and, assuming operation on this frequency, the diodes in the bridge rectifier are all driven into brief conduction at a 50 kc/s rate and are non-conducting when reverse biased. Gated pulses at half the input rate of the 100 kc/s source are thus applied to the transistor and serve to maintain the 50 kc/s output. The series-connected 200 pF and 1,000 pF capacitors provide at their junction a source of positive feedback or regeneration for application to the transistor emitter. Self-oscillation in the absence of 100 kc/s drive is prevented by reverse emitter bias taken from the junction of the 2.7 kΩ and 1.8 kΩ resistors.

Simple as this circuit may appear, it is less toler-

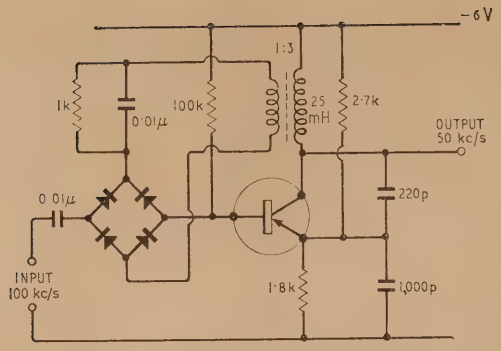

Fig. 7. Regenerative modulator divider.

ant of supply voltage, drive frequency and drive amplitude changes than the parametric divider of Fig. 4. Moreover, the waveform is no better.

For use in low power circuits the parametric divider is a useful alternative to the other possible arrangements. It is simple to align and adjust, has an inherent fail-safe property and gives a near-sinusoidal output which is easily filtered to remove unwanted harmonics. It can be designed to operate over an enormous range of frequencies and is potentially useful in frequency-synthesizers which rely on binary division and mixing to generate a wide range of stable frequencies. The output is free from random noise and, with care, the output of one stage may be used to drive the next although there are advantages in separating two such stages by a tuned amplifier which may then be used to supply useful power to an external load.

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2. F. Butler, "Reactance Modulator Theory." *Wireless Engineer*, Vol. XXV, No. 294, March, 1948, p. 69.
3. A. R. Saha, "Transistor Parametric Subharmonic Generator," *Journal of Electronics and Control*, 1st Series, Vol. XV, No. 1, July, 1961, p. 21.

Commercial Literature

The "**Taylor Transistor Handbook**" recently introduced as a companion to their transistor tester is now available separately, priced at 25s, from Taylor Electrical Instruments Ltd., Montrose Avenue, Slough, Bucks. This 116-page publication contains information on British, Continental, American and Russian transistors and also includes a list of manufacturers' names and addresses. All the basic parameters are given together with maximum ratings and connection data.

4WW 411 for further details.

The engineering staff of E. H. Research Laboratories, Inc., of California, have prepared a booklet to assist engineers in **selecting and using pulse generators.** Although occasional reference is made to E. H. equipment, the publication is of general nature and is subdivided into four sections covering basic pulse generator definitions, pulse generator circuits, pulse characteristic measurements and applications. Copies of this 36-page booklet are obtainable from the U.K. agents, Livingston Laboratories Ltd., 31 Camden Road, London, N.W.1.

4WW 412 for further details.

Thorn-A.E.I. Radio Valves & Tubes Ltd. have produced a booklet describing the mass production of **television cathode ray tubes** at their Sunderland tube factory. The booklet, entitled "Quality in Quantity," was written originally for presentation to visitors touring the factory, but it may be of general interest. It describes the assembly processes, the function of each component and its contribution to the tube performance and reliability. Copies are available from the Thorn-A.E.I. Publicity Department, 155 Charing Cross Road, London, W.C.2.

4WW 413 for further details.

A number of technical bulletins have been sent to us by the Telegraph Condenser Company, of North Acton, London, W.3, on their **capacitors.** Bulletin No. 89R deals with their "Supamold" paper dielectric capacitors, 90R with "Duomold" mixed dielectric capacitors, 93 with miniature metallized polyester capacitors, 95 with ceramic disc power capacitors and 98 with "Metamold" tubular metallized polyester capacitors.

4WW 414 for further details.

The 1963-64 **Marconi Instruments catalogue** is now available from their head office at St. Albans, Herts. This 208-page catalogue contains general and technical information on all the instruments and accessories they manufacture. These include oscilloscopes, oscillators, generators, voltmeters, frequency meters and counters, power meters, impedance bridges and "Q" meters. Associated companies and distributors are also listed in this catalogue. There are also French, German and Italian editions of this catalogue.

4WW 415 for further details.

Single-phase and three-phase **Trinistor a.c. power regulators** are described in the Westinghouse engineering publication 22-4/2. It contains full technical details and explanatory diagrams on the method of regulation. Copies of this publication are obtainable from the rectifier division of the Westinghouse Brake and Signal Company, 82 York Way, King's Cross, London, N.1.

4WW 416 for further details.

"**The use of voltage reference diodes in stabilized supplies**" is the title of a new 20-page application report on semiconductor devices, published by A.E.I. Temperature compensation, output voltage stability and the design of a high stability reference are among the subjects dealt with in this booklet. Copies of the publication (4450-203) are available from the valve and semiconductor sales department of the Electronic Apparatus Division of Associated Electrical Industries Ltd., Carholme Road, Lincoln.

4WW 417 for further details.

Muirhead and Co. Ltd., of Beckenham, Kent, have produced a booklet titled: "**A comparison of the unsaturated standard cell and the Zener diode as a voltage reference.**" It is based upon a paper by John M. Fluke and Robert W. Hammond, of the John Fluke Manufacturing Company, of Washington. Copies of this booklet which are intended "to place the relative merits of these two voltage references in perspective and assist those concerned with them to choose the right device for every application" and leaflets on Muirhead standard and reference cells are obtainable from the Publicity Dept. of Muirhead's.

4WW 418 for further details.

Tape Recording Amplifier

CIRCUIT WITH CATHODE FOLLOWER OUTPUT STAGE

By G. P. HOBBS, B.A., Grad. I.E.E

THERE are, no doubt, numerous permutations of circuit arrangements to be found in use in amateur built tape recording equipment. Indeed, in the integration of his equipment the constructor may prove to be very much of an individualist, perhaps taking special pride over the particular switching facilities he has evolved. It is thought that readers might be interested in the line of thought followed in this article over the design of one section of the electronics: the record amplifier.

A few words about the other elements of the writer's equipment may also be of interest. At one time the replay amplifier had used three EF86 valves in a circuit arrangement equivalent to the transistor amplifier described in *Wireless World* by P. F. Ridler.[1] It was found, however, that the three-transistor circuit achieved a better noise performance. Subsequent replacement of the first EF86 stage by an OC44 gave a performance as good as that of the Ridler circuit. For a really good signal to noise ratio on the tape a first-rate bias oscillator is necessary, and here a twin triode as a push-pull oscillator is made to drive a power amplifier, also in push pull. Using high-Q circuits in the oscillator and at the anodes of the power amplifier a good waveform is readily attained.

Recording Considerations

In the recording stage a transistor amplifier might be considered. However, if the head is of high impedance and is driven through a series resistor in the conventional manner there is likely to be lack of sufficient voltage drive. A high source impedance from a transistor circuit can be achieved by other means,[2] but here the design is centred around the familiar 12AT7. Too often the recording amplifier and equalizing circuits receive less attention than they deserve. The weakest link ought to lie in the tape itself: the distortion and dynamic range should only be determined by the actual physical recording process and not by the driving amplifier.

The amplifier should have, as well as better linearity than the tape, a really adequate signal-handling capacity. The tape will then saturate well before the amplifier limits. Full modulation of the tape is generally taken to correspond to the signal level that produces 3% harmonic distortion in the recording, and the programme level will be set to allow just the loudest passages to reach this. It takes, however, a signal 12dB greater than this to saturate the average commercial tape. Exceeding the maximum recording level does, of course, introduce bad non-linearity but this extra 12dB can serve a useful purpose. Accidental over-recording immediately springs to mind, but more important than this is the handling of short-duration peaks. Both music and speech do contain occasional peaks well above the general level of sound intensity which last perhaps only for a few milliseconds. By good fortune the ear is unable to detect whether these have become distorted—provided their duration is short. If the level indicator is unresponsive to these peaks, showing the peak level of longer signals only, the level will unconsciously be set to allow these peaks to overmodulate.[3] Thus we have an advantage to be gained if the recording amplifier will handle the peaks without clipping.

To visualize the demands we have made on the recording amplifier, consider a typical head with inductance 250mH. For maximum recording level the head will require about 100μA r.m.s. signal current. A substantially constant current drive versus frequency will be obtained with a feed resistor of 100 kΩ. The voltage drive for full modulation is therefore 10V r.m.s. Well in excess of 40V r.m.s. must be available before limiting occurs. Much the same drive will be needed for heads of other inductance as the following analysis shows.

The voltage drive is

$$V = RI \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where R is the feed resistor and I the recording current Now all heads will require about the same ampere turns for a given recording flux. Therefore

$I \propto \frac{1}{n}$ where n is the number of turns on the head bobbin and this in turn is proportional to the square root of the inductance

$$\therefore I \propto \frac{1}{\sqrt{L}}$$

Now we must also choose $R \propto L$ for a substantially constant current drive From expression (1) we have $V \propto \frac{L}{\sqrt{L}} \propto \sqrt{L}$, that is the voltage drive required is proportional to only the square root of the inductance. This shows that it is an advantage to go for a head of low inductance, quite apart from the advantage this brings of low self capacitance.

Circuit

The drive requirements for a 250mH head are amply met by the circuit of Fig. 1. This employs a cathode follower output stage and a degree of overall feedback.

The foremost advantage the cathode follower brings is in isolating the a.c. loading of R_{14} from the anode of V2. As the anode resistor of a triode stage

is increased, the distortion, for a given output swing, tends to decrease. The loading factor for a capacitively coupled 100kΩ resistor would, however, deteriorate. The cathode follower output stage avoids any compromise solution here and makes certain of ample available swing.

The arrangement has attendant favourable properties for rejection of the bias voltage. The bias signal across the recording head generally lies between 20 and 100V r.m.s.—quite a considerable voltage owing to the high head impedance at bias frequency (the bias current being several times greater than the peak-recording current). Should much of this voltage be allowed to reach the output of the recording amplifier, the working point would be forced to move at bias frequency. To prevent any distortion the amplitude of bias voltage at the amplifier output must be kept low, especially if the recording-level indicator is also connected to this point. By now the reader may have realized that the cathode follower inherently gives excellent bias rejection—by virtue of its low output impedance. The bias voltage is attenuated, by the potentiometer formed by R_{14} and the impedance at the cathode of V3 to a very small amplitude. Moreover, this arrangement is effective at all frequencies and no setting up is necessary as is the case with a tunable rejector filter. V3 then, is the cathode follower output stage. V2 is a straight amplifier providing 10V r.m.s. signal at the anode for maximum recording level.

With the component values shown and an anode current of 2mA for V2, there will be about 4% harmonic distortion at this level. V1, also a voltage amplifier, has feedback from V3 applied to the cathode. Noting that the harmonic distortion would be small in the first place (4%), we may safely say that the distortion will be reduced by an amount equal to the feedback factor. At most frequencies the harmonic distortion should not exceed 0.2% for 10V r.m.s. output. At the frequency for which maximum treble boost occurs there is less feedback but the distortion should still be under 1%. We have an amplifier therefore that introduces negligible additional distortion to that incurred in the actual recording process. The characteristics of the magnetic tape will be fully exploited.

One elementary point that needs attention is the application of feedback around a loop containing two coupling capacitors, C_3 and C_6. Should the time constants associated with these two be similar, a phase shift exceeding 90° could occur. Instability at very low frequencies has been avoided by making the time constant at C_6 very long. Due to cathode follower action, the impedance at the grid of V3 is of the order of 15MΩ and only a small coupling capacitor would have been needed if it had not been for this problem. In fact, using $C_6 = 0.01\mu F$ caused some ringing at a sub-audio frequency, $0.1\mu F$ was found to be quite free from this effect, and a $0.25\mu F$ was adopted to give a wide margin of stability.

A single pole switch, SW_1, is used to break the H.T. supply to the oscillator and to the anode of V1. In the absence of anode current the grid of this valve is still held negative with respect to the cathode because the anode current of V3 also flows through R_4. The audio signal is effectively cut off, and, provided the record head is not used for the playback function, there is no need for any switching at the head itself.

The gain from the input to output of the amplifier

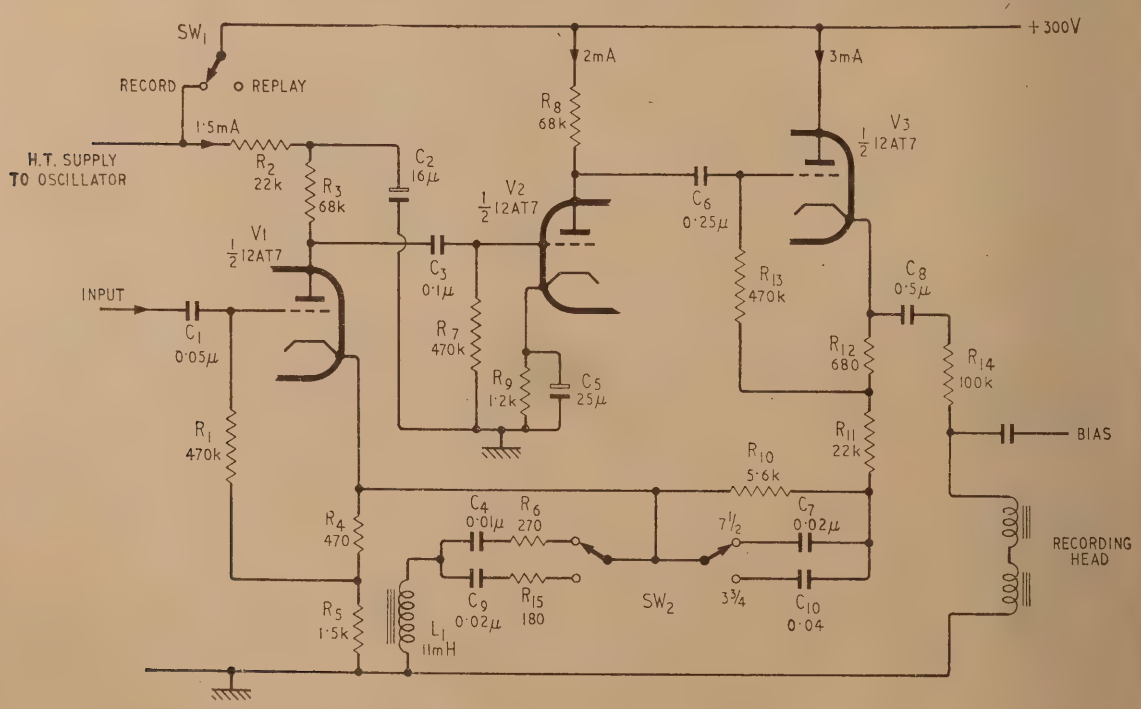


Fig. 1. Circuit of recording amplifier. The resistors are all ½W 10%. Inductance L_1 is 11mH (approximately 175 turns 34 s.w.g. on Mullard LA1 pot core).

at low frequencies is given very nearly by

$$\frac{R_4 + R_5 + R_{10} + R_{11} + R_{12}}{R_4 + R_5} \quad \ldots \quad (2)$$

which with the values used is $\frac{30k\Omega}{2k\Omega} = 15$.

Therefore at maximum recording level 700mV r.m.s. signal input is required. The odd half of a 12AT7 left over could well serve as a pre-amplifier to provide this. In the writer's case it is used as a cathode follower in front of V1. In this way it serves as a buffer stage which enables a monitoring amplifier to be connected to the grid of V1 without disturbance of the level.

The expression given for the gain in expression (2) is modified at high frequencies by the parallel impedance presented by R_6, C_4, L_1 across $R_4 + R_5$. The gain rises with frequency as the impedance of the network R_6, C_4, L_1 drops. At first C_4 mainly determines the shape of the rising characteristic, but L_1 becomes increasingly effective until the gain rises sharply towards the resonant frequency of the series tuned circuit. The degree of boost at the resonant frequency is controlled solely by R_6. The higher the chosen resonance, the more lift will be required and the larger the Q of the tuned circuit. This is typically about 4 so that we are justified in neglecting the losses in the pot core. The bandwidth in playback is about equal to the resonant frequency of C_4 and L_1. So much for the effects of R_6, C_4 and L_1 but what determines the choice of their component values?

This is best answered by examining the recorded magnetic flux on the tape that results from a constant current versus frequency recording. This is illustrated by the broken curve of Fig. 2. The full curve shows the recorded flux according to the C.C.I.R. standard for a tape speed of 7½in/sec. Because it is a comparatively simple matter to arrange a CR network in the playback amplifier to replay a tape recorded to the full curve characteristic correctly, the problems of equalization are relegated to the recording amplifier. Basically we need to provide pre-emphasis to make up the difference between the two curves of Fig. 2; how far this is carried out is a compromise between frequency response and dynamic range at the higher frequencies.

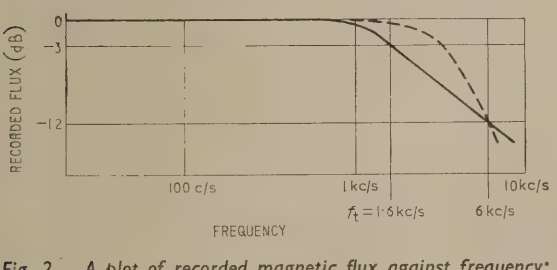


Fig. 2. A plot of recorded magnetic flux against frequency. The continuous line is the C.C.I.R. characteristic for 7½ in/sec. The broken line represents a constant current recording.

The C.C.I.R. standard specifies that the recorded magnetic flux should be constant at low frequencies and fall at 6dB/octave above the turn over frequency f_t. More familiar with most people will be the plot of signal voltage developed across an ideal replay head shown in Fig. 3.

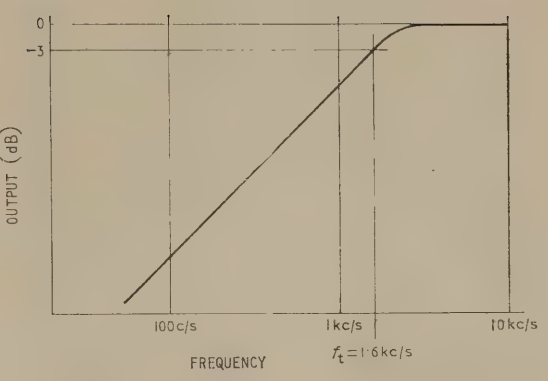


Fig. 3. Output from an ideal replay head from a tape recorded to the C.C.I.R. characteristic for 7½in/sec.

This includes the 6dB/octave rise in output derived from the inductive nature of the head. The output voltage is, of course, proportional to the rate of change of magnetic flux induced in the head and doubles as the frequency doubles. Both characteristic curves of Figs. 2 and 3 have a flat region and a sloping region with a turn over or 3dB point, f_t. In terms of a CR time constant, we have $f_t = \frac{160}{CR}$kc/s, where CR is in microseconds. At 7½in/sec. the C.C.I.R. standard is 100μsec. so that $f_t = 1.6$kc/s. The playback amplifier requires equalization which is the mirror of Fig. 3 and so CR is also the time constant needed there. Some slight high-frequency lift may also be necessary in this amplifier to compensate for losses resulting from the finite gap width of the replay head.

Returning to the broken curve of Fig. 2, the recorded flux is seen to remain constant over the low and middle frequency range, but, because of severe losses incurred in the recording process, falls rapidly at high frequencies. The standard characteristic also falls at high frequencies—but only at a rate of 6dB/octave—and is a concession to the great losses that do occur. The broken curve first lies slightly above the full curve but then rapidly falls below it. The network C_7 R_{10} introduces a small loss to offset this former condition. The overall response would otherwise have a small hump of about 2dB at 4kc/s. Experiment then showed that a pass band up to 15kc/s could be obtained with $R_6 = 270\Omega$, $C_4 = 0.01\mu F$ and $L_1 = 11mH$, the maximum lift being 14dB relative to 1kc/s. Some of this lift could, however, be making good gap losses on playback, which, in the absence of a test tape going above 10kc/s were not known. It would be prudent to mention the conditions under which this result is achieved, as slightly different equalization may be needed by other people's equipment.

Recording head	Brenell R-P, 0.00025in gap.
Bias frequency	90kc/s.
Bias amplitude	Optimum — maximum output at 1kc/s.
Tape	Scotch 150.
Replay head	Bogen UK 100, 0.00012in gap.
Replay amplifier	100μsec., 7½in/sec. characteristic.

All these items will be individual to a particular

set-up, but the factor which has by far the greatest influence on the results is the bias amplitude. The optimum bias current is defined as that which gives the greatest output on playback from a 1kc/s tone. The distortion for this value of bias is around a minimum. The maximum output at other frequencies occurs at only slightly different bias settings but a given increase in bias current causes a loss in output which is much greater at high frequencies. For instance, an increase above optimum for a drop of 1dB at 1kc/s (7½in/sec.) causes a drop of 2.5dB at 10kc/s and 6dB at 15kc/s.

The circuit of Fig. 1 also shows equalizing components for 3¾in/sec. tape speed. This is intended for a replay time constant of 200μsec. and gives a pass band up to 11kc/s. Although 200μsec. has been a popular choice for 3¾in/sec. in this country, the appearance of American "pre-recorded" tapes has caused some manufacturers to change over to 120μsec. The 120μsec. characteristic does fit the equivalent constant current curve of Fig. 2 better than 200μsec. in that no hump occurs; C_7 becomes unnecessary. However more pre-emphasis is required for a given pass band. Excessive lift might mean that the recording level would have to be held back to prevent unpleasant treble distortion. The dynamic range would be less and this is equivalent to saying that the signal to noise ratio would be worse. Some treble lift is usually permissible with most types of programme material without reduction of the recording level because less energy is concentrated in the upper audio frequencies. However the problem at 3¾in/sec. is aggravated by the lower frequency of maximum boost and the desire to use as much boost as possible to obtain the widest bandwidth.

In conclusion the writer would like to emphasize that the necessary equalization on record will vary from one tape machine to another. The component values given for R_6, C_4 and L_1 are intended as a guide only.

REFERENCES

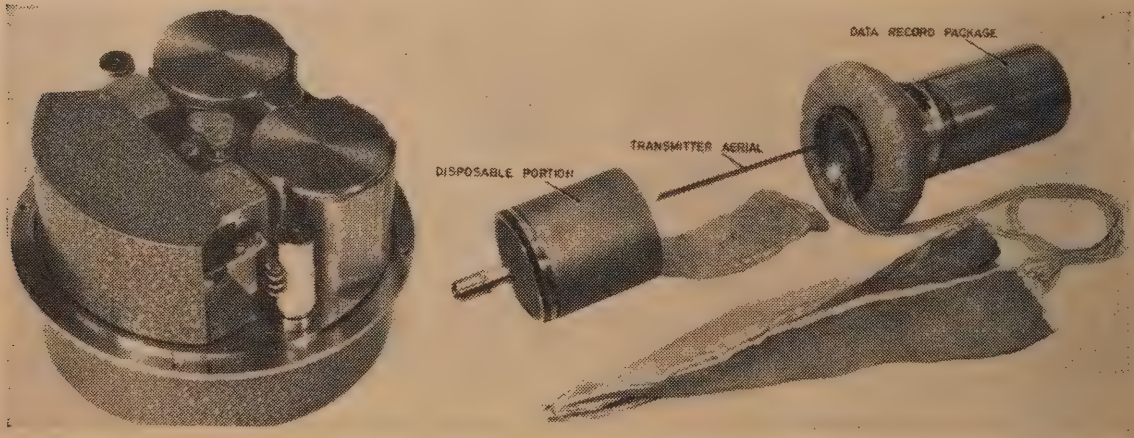
1 "High Quality Tape Pre-amplifier," P. F. Ridler, *Wireless World*, February, 1962.
2 "Transistor Tape Recorder Amplifier," P. W. Blick. *Wireless World*, April, 1960.
3 "Studio Engineering for Sound Broadcasting," page 167 (Iliffe Books).

AIRCRAFT ACCIDENT RECORDER

THE rapid conclusion of the enquiry into the B.A.C. One-Eleven crash has demonstrated in no uncertain manner the value of ejectable data recorders. When one remembers the months of work that were needed to locate and analyse the debris of the Comet II that disintegrated in the Mediterranean, the fact that only recently have recorders been used seems all the more remarkable. It appears almost certain that the more expensive prototypes and larger civil aircraft will now carry recorders, and Redifon have recently announced that the later TSR-2 prototypes will be fitted with their new accident data recorder, which is based on a design by R.A.E., Farnborough. This is designed to provide a record which will survive under extreme conditions of heat, humidity and vibration, of the last 15 minutes of flight.

Using the principle of time-division multiplexing, 280 channels per minute are sampled, and a channel is provided for recording the pilot's speech. The 1-in wide tape takes 7½ minutes to traverse in one direction, after which it reverses and changes to the other track. When both tracks have been recorded, that is, after 15 minutes, the data first obtained is continuously erased and new data recorded. Normally, the recorder and its associated encoders are powered by the aircraft's supply, but if this fails, internal batteries are quickly brought into service automatically.

The recording head and tape cassettes are enclosed in a cylindrical capsule and are ejected by a mechanism, developed in collaboration with M.L. Aviation, when in contact with water, fire or excess G forces, the "trip" limits for the latter being adjustable. Ejection can take place at altitudes up to 70,000 feet and speeds up to 1,000 m.p.h., and from 30ft below the surface of the sea. A parachute and flotation bags are deployed on ejection, and the capsule has a transmitter with batteries giving 48 hours of transmitting time.

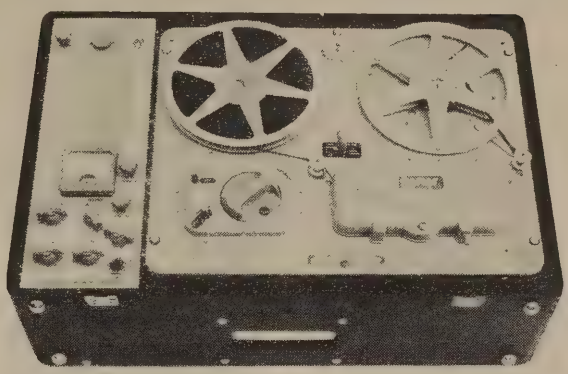


Left: Recording head and tape canisters, which are ejected. Right: Components of ejected capsule.

—Vortexion

quality equipment

TYPE W.V.B.
TAPE RECORDER



THE VORTEXION C.B.L. RECORDER has had many detail improvements and additions using the latest stereo deck, " B " type monitoring after record facilities with mixing of inputs on each channel and over 6 watts total output. All the usual features of the " B " recorder are retained, including metering of bias and signal plus the ability to record the signal from one track to the other together with additional signal from the mixed inputs. The separate 30/50 ohm balanced line microphone inputs allow for the microphones to be placed any distance apart according to the result required. The right hand channel may be switched off entirely when only single channel working is desired.

THE VORTEXION " B " RECORDER is noted for its very high audible quality and professional standards. The microphone input can have over a quarter-mile of ordinary twin flex for outdoor use and will load from normal voice at a distance of 20 feet, being of 30/50 ohm balanced line needing only 8 micro-volts. The radio input can accept any signal from 17 m.v. to 10 volts on 0.5 megohm. Monitoring after record facilities are provided with A-B switch for comparing the before and after quality whilst recording, and the erase head may be switched out, the bias reset and monitored on the meter for superimposing and adding echoes, etc. The handbook contains the accurate meter bias settings for various makes of tape, and 3½ watts of power heavily damped by negative feedback on 15 ohm is available. **THE W.V.A. RECORDER** is similar except for the " B " type monitoring.

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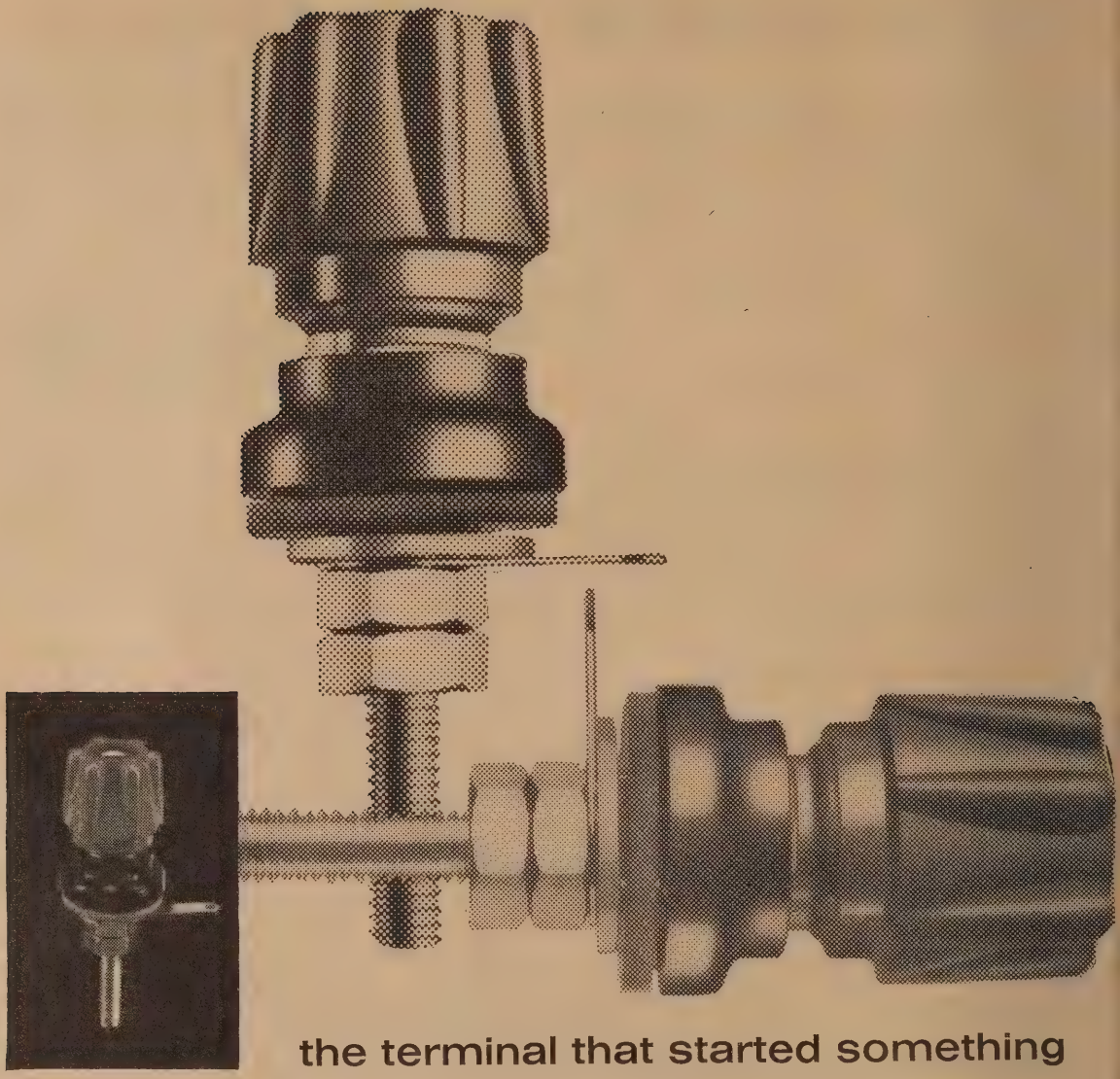

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Acoustic Noise Measurement and Analysis

By W. V. RICHINGS,* Assoc.I.E.E., A.M.Brit. I.R.E.

THE recent publication of the Wilson Committee Report [1] has focused attention on the growing problem of noise, defined here as unwanted sound. In the extreme, prolonged exposure to very high level sounds creates a serious risk of permanent hearing loss and even damage to structures when the exceedingly high noise levels from rocket motors are considered. At the levels commonly encountered noise can be distracting, annoying and interfere with speech or other wanted sounds.

The purpose of this paper is to describe some of the applications of modern electro-acoustical instrumentation to the problems of noise measurement. By way of introduction, the various terms used in noise measurement are explained.

Sound Pressure and Decibels

Sound waves cause variations in the normal atmospheric pressure. The atmospheric pressure is expressed in dynes per square centimetre (dyne/cm^2) for scientific work, one dyne/cm^2 being about one millionth of the normal atmospheric pressure. The range of sound pressure to which the ear responds is approximately 0.0002 to 200 dyne/cm^2, the relative levels of typical noises being shown in Table 1. For convenience a logarithmic unit, the decibel, has been borrowed from telecommunications engineering to cover this wide range with easily manageable numbers. Strictly the decibel (dB) is ten times the logarithmic ratio of two powers and since sound power is proportional to (sound pressure)^2 the number of decibels, N, between two pressures p and p_0 is given by:

$$N \times 10 \log_{10} \left(\frac{p}{p_0}\right)^2 \times 20 \log_{10} \frac{p}{p_0}$$

Since the decibel value implies a ratio, the reference level p_0 must always be stated or at least clearly understood. For sound pressures, the internationally agreed reference level is 0.0002 dyne/cm^2 which is in

* Dawe Instruments Ltd.

TABLE 1

Noise	Decibels	Relative Energy	Sound Pressure Dyne/cm^2	Typical Examples
PAINFUL	120	1,000,000,000,000	200	
DEAFENING	110	100,000,000,000		Jet aircraft at 500ft. Inside boiler making factory Near pneumatic drill Motor horn at 20ft.
	100	10,000,000,000	20	
VERY LOUD	90	1,000,000,000		Inside tube train Busy street Workshop Small car at 24ft.
	80	100,000,000	2	
LOUD	70	10,000,000		Noisy office Inside small car Large shop Radio set—Full volume
	60	1,000,000	0·2	
MODERATE	50	100,000		Normal conversation at 3ft. Urban house Quiet office Rural house
	40	10,000	0·02	
FAINT	30	1,000		Public library Quite conversation Rustle of paper Whisper
	20	100	0·002	
VERY FAINT	10	10		Quiet church Still night in the country Sound-proof room Threshold of hearing
	0	1	0·0002	

the region of the threshold of audibility for a 1000 c/s pure tone. Sound pressures referred to this level are defined as "sound pressure levels". Thus:—

$$\text{Sound pressure level} = 20 \log_{10} \frac{p}{0.0002} \text{ dB}$$

Table 1 also shows the corresponding sound pressure levels for typical noises.

Sound pressure levels expressed in decibels, cannot be added arithmetically, for example 80dB + 80dB does not equal 160dB. In fact two equal sound pressure levels give an increase of 3dB. Thus 80dB + 80dB gives a total sound pressure level of 83dB. In the general case it can be shown that:—

$$N = 10 \log_{10} (10^{\frac{N_1}{10}} + 10^{\frac{N_2}{10}} + 10^{\frac{N_3}{10}} + ..)$$

where N = total sound pressure and N_1, N_2, N_3 .. are the separate levels being added.

This expresses in terms of decibels, the well-known relation that the effective (r.m.s.) value of a number of random electrical or acoustic signals is the square root of the sum of the squares of the individual voltages or sound pressures. It may be noted in passing that for the very special case of adding two voltages or sound pressures which have the identical frequency and phase, the increase in overall level is 6dB.

The scale, Fig. 1, simplifies the problem of combining sound pressure levels. First subtract the largest sound pressure level from the second largest value. Below this difference on the upper scale, the number of decibels to be added and to give the total sound pressure level is determined from the lower scale. Taking the previous example, for $N_1 = N_2 = 80$dB, $N_1 - N_2 = 0$ on the upper scale, which corresponds with 3dB on the lower scale, giving a total value of 80 + 3 = 83dB. To find the sum of more than two levels, the two largest are first added as described above and the other levels then added one at a time. When the difference in levels is more than 10 to 15dB, the amount to be added becomes negligible since the accuracies with which sound pressure levels can be measured rarely justifies quoting values to closer than the nearest whole decibel.

Loudness and Loudness Level

A major subjective characteristic of a sound is the loudness, that is an observer's auditory impression of the strength of the sound. The loudness is primarily related to the sound pressure although, due to the complexity of the response of the human ear, other factors are also involved. The unit of *loudness level* is the *phon* which is defined[2] on the basis of a subjective comparision between the sound being considered and a sensibly plane sinusoidal progressive sound wave of 1000 c/s coming from directly in front of the observer. When the two are judged to be equally loud, the loudness level in phons is numerically equal to the sound pressure level of the 1000 c/s reference tone.

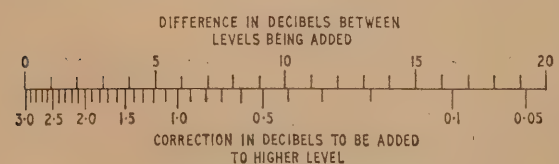


Fig 1. Scale for combining sound pressure levels.

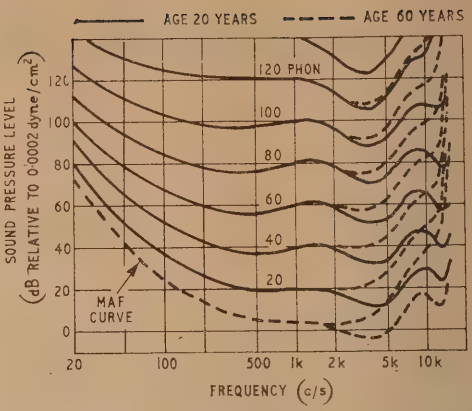


Fig. 2. Equal-loudness contours for pure tones. (Robinson and Dadson).

The ear is not equally sensitive to all frequencies and Fig. 2 shows the sound pressure level in decibels of pure tones at various frequencies required to produce equal sensations of loudness in phons, taking the average of a number of observers. For a group of observers the majority will normally agree within 6 phons, although individual estimates may differ by 10 phons or more. The equal loudness contours of Fig. 2 are taken from the results of work carried out at the National Physical Laboratory by Robinson and Dadson[3] and form the basis of British Standard 3383 : 1961[4]. These curves differ to some extent from those obtained earlier by Fletcher and Munson (1933) and by Churcher and King (1937).

No zero phon curve is given, because the threshold of hearing at 1000c/s has been found to be about 4dB above the standard reference level (0dB = 0.0002 dyne/cm²), so that the lowest curve is that for the minimum audible field (M.A.F.).

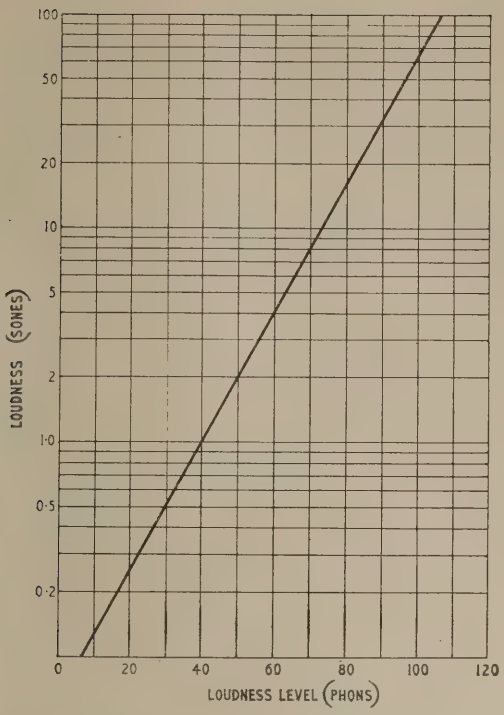
The phon scale relates the sensitivity of the ear at various frequencies to that at 1000c/s but does not give a direct indication of the change in level necessary, to, say, double the loudness of a sound. For this purpose the *sone* scale of *loudness* has been devised. The reference point of this scale is taken arbitrarily as a loudness of 1 sone for a loudness level of 40 phons. Then a sound which is n times as loud as the reference has a loudness of n sones. It has been found experimentally that for practical purposes, doubling the loudness corresponds to an increase of loudness level of 10 phons. Similarly a reduction in loudness level of 10 phons halves the loudness. The relationship between the loudness level (P) in phons and the loudness (S) in sones is given by the formula:—

$$P = 40 + 10 \log_2 S$$

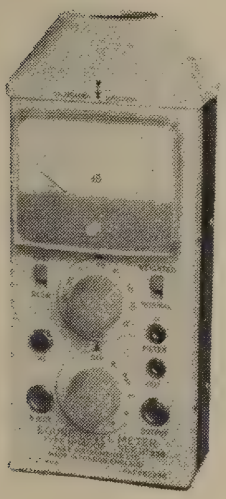
This phon—sone function has been standardized in Great Britain, British Standard 3045 : 1958[5], and internationally[6] and is shown graphically in Fig. 3.

It should be noted that equally loud sounds are not always equivalent in other respects, for example two sounds of equal loudness may differ in annoyance or in the degree to which they interfere with speech.

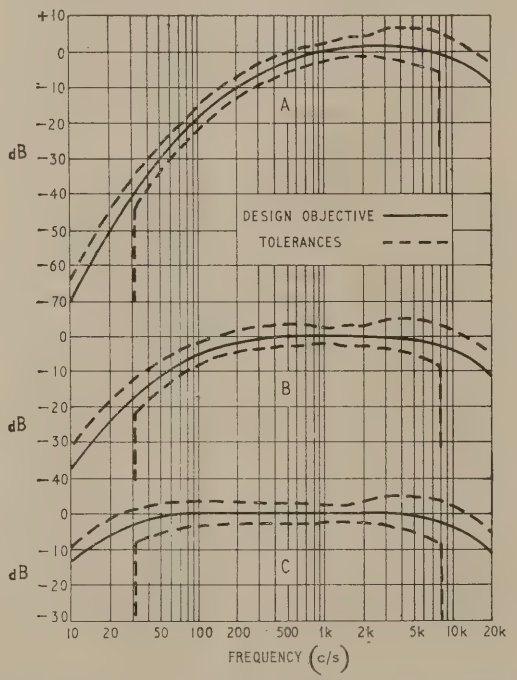
The fundamental method for determining loudness level in phons requires a number of observers and carefully controlled laboratory experiments. This is impractical for routine noise measurements and an objective method of measurement using a sound level meter has been standardized. The *sound level*



Above—Fig. 3. Relation between loudness and loudness level.



Left—Typical sound level meter to British Standard and I.E.C. requirements (Dawe Instruments)



Right—Fig. 4. Overall frequency response with three different weighting networks.

in decibels is defined as the sound pressure level measured with a sound level meter having certain frequency characteristics and other performance requirements specified in British Standard 3489 : 1962[7] and International Electrotechnical Commission (I.E.C.) Publication 123[8].

The sound level meter consists of a microphone, amplifier, weighting networks and an indicating meter. The weighting networks provide the frequency response characteristics A, B and C shown in Fig. 4. Historically these were intended to simulate the frequency characteristics of the ear at low, medium and high levels respectively. However, extensive tests have shown that in many cases sound level A is found to correlate best with subjective noise ratings. Current recommendations for rating noise with respect to hearing conservation, speech communication and annoyance propose that sound level A should be used for screening purpose to indicate whether more detailed measurements are necessary. When the sound level meter is used with a filter for frequency analysis, sound level C is required to provide a substantially flat response over the frequency range 31.5c/s to 8000c/s.

The sound level meter reading does not in general correspond with the loudness level in phons. However, in spite of this limitation, the sound level meter is widely used for practical noise measurements. It provides a simple, consistent means for the comparison of results and to place noises of similar character in rank order.

In reporting the results it is important to state the weighting network which was used, for example to note that the sound level was, say, 85dB(A).

Loudness Calculation

Various procedures have been evolved to calculate a value of loudness level from a frequency analysis of the sound pressure level, taking into account some of the more complex characteristics of the ear.

A method of calculation proposed by Stevens[9] forms the basis of a draft I.S.O. procedure using a broad-band frequency analysis. The level in each band is converted into a " loudness index " by means of curves (Fig. 5) or tables. These curves originate from equal loudness contours for bands of noise in a diffuse sound field. The total loudness index is then found by means of the formula:—

$$S_t = S_m + F(\Sigma S - S_m)$$

where S_m is the greatest of the loudness indexes.

ΣS is the arithmetic sum of the loudness indexes of all the bands.

F depends on the bandwidth (0.15 for one-third octave or 0.3 for octave bands).

The calculated loudness level is then determined

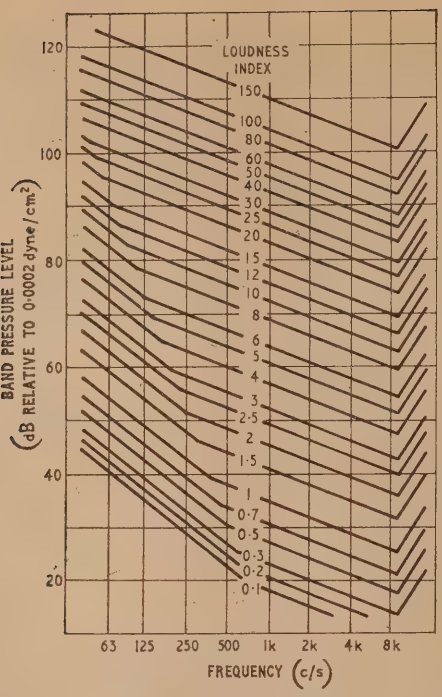


Fig. 5. Relation between band pressure level and loudness index.

by means of the formula corresponding to the phon-sone relationship described previously (Fig. 3).

The draft recommendation gives preference to octave bands for this method, but one-third octave bands can also be used. For the I.S.O. procedure using octave bands, the loudness index is in units of sones (OD) and the loudness level in phons (OD), the "OD" signifying " octave, diffuse " as the basis of computation.

The preferred procedure using one-third octave band levels is based on a method proposed by Zwicker[10]. The total loudness is determined from the band levels as the area under specially prepared graphs which take into account subjective characteristics such as masking. The loudness level is then obtained from the phon-sone relationship. (Fig. 3.) For a diffuse sound field, the units of loudness and loudness level calculated by this method are sones(GD) and phons(GD) respectively. For a free sound field the corresponding units are sones (GF) and phons(GF).

It should be noted that the calculated results obtained by the various methods do not always agree exactly with one another or with the subjectively determined loudness level in phons.

Noise of Motor Vehicles

The results of a survey reported by the Wilson Committee[1] show that road traffic is the major source of noise which disturbs people at home or outdoors. This is perhaps not surprising with the rapidly increasing number of vehicles on the roads together with their improved performance and power. Extensive tests have been carried out in this country by the Ministry of Transport, the Motor Industry Research Association and the National Physical Laboratory on methods of measurement of vehicle noise. As a result of this work a British Standard 3425 : 1961[11] has been published describing the procedure necessary to achieve consistent and reproducible measurements. The procedure requires an open test site to avoid reflections from surrounding buildings and other obstacles The vehicle accelerates at full throttle from a stated driving condition past the microphone of a sound level meter. The microphone is mounted at a height of 1.2 metres (3ft 11in) and at a distance of 7.5 metres (24ft 7in) from the centre line of the vehicle. The work mentioned above and similar experiments abroad have shown that the sound level A gives an acceptable correlation with subjective listening tests and has thus been specified for vehicle noise measurement.

British Standard 3539 : 1962[12] specifies the performance of the high-quality sound level meters needed to carry out these tests. Two special sound level meters are described elsewhere[13]. The first, known as a " Vehicle Noise Meter," is for testing stations and vehicle manufacturers where the full requirements of British Standard 3425 : 1961 relating to the method of driving the vehicle apply. The second instrument, known as a "Traffic Noise Meter," is intended for roadside checks by police and other authorities where it is required to determine whether the noise exceeds a specified value. The operation is simplified to avoid the possibility of incorrect setting of the controls by the non-specialist user.

The Ministry of Transport has recently issued draft regulations proposing that the noise level of new motor vehicles when tested in accordance with British Standard 3425 : 1961 should not exceed 90dB(A) for motor cycles and 85dB(A) for other vehicles. The higher value suggested for motor cycles has been chosen to allow for the consistently higher reading on a sound level meter given by motor cycles as compared with other vehicles which were judged equally noisy. The draft regulations also propose that the noise levels of vehicles on the road should be measured under suitable conditions and that it should be an offence for the noise measured to exceed by more than 3dB the levels given above for new vehicles. These limits are a compromise between what is acceptable to the public and what is technically possible at reasonable cost. However the recommendations, if adopted, should considerably reduce the number of noisy vehicles and discourage drivers from creating unnecessary noise.

Aircraft Noise

The total acoustic power radiated by a modern jet aircraft amounts to tens of kilowatts. This indicates the magnitude of the noise problem in the vicinity of airports and it is not surprising that the number of complaints has increased rapidly in recent years. Strenuous efforts to reduce the noise are being made by the engine manufacturers, but since the acoustic output is already no more than a few per cent of the total power output, only gradual improvements can be expected. The noise can be alleviated to some extent by adopting special take-off and landing procedures and where possible using runways directed over the sea or sparsely-populated areas.

The noise of aircraft using major airports is monitored and recorded as *perceived noise level* in

units of PNdB (perceived noise decibels). Maximum levels of 110-112 PNdB have been adopted for daytime operations and about 102 PNdB during the night. This method of noise rating[14] is patterned after that proposed by Stevens for calculating loudness and loudness level[9] using a broad-band frequency analysis. In this case equal *noisiness* contours or tables are used to convert the band pressure level into noisiness in *noys*. The total noisiness is calculated from:—

$$N_t = N_m + F(\Sigma N - N_m) \text{ noys}$$

where N_m is the noisiness in the noisiest band.

ΣN is the sum of the noisinesses of all the bands.

F depends on the bandwidth (0.15 for one-third octave or 0.3 for octave bands).

The perceived noise level in PNdB can then be determined from the phon-sone relation (Fig. 3).

It may be noted that noys are analogous to sones and PNdB to phons in the Stevens method.

For aircraft noise, it is possible to obtain an close approximation to the calculated perceived noise level by using a sound level meter with the N weighting curve (Fig. 6).

Some modification of the equal-noisiness contours and tables for frequencies above 1000 c/s has recently been proposed as a result of further work[15]. Both the original 1959 and the revised 1963 curves are shown in Fig. 6.

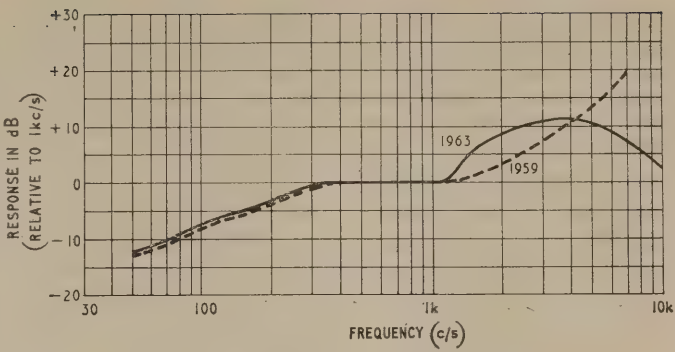


Fig. 6. N weighting curve for perceived noise.

Noise Rating

Various methods for rating with respect to hearing conservation, speech communication and annoyance have been proposed and are under discussion as the basis for an I.S.O. recommendation. From a frequency analysis of the noise using a sound level meter and octave band filter, the "noise rating" of each octave band sound pressure level is determined from noise rating curves (Fig. 7. The *noise rating number N* of the noise is the highest of the octave band values.

In rating a noise with respect to the risk of permanent impairment of hearing the octaves with mid-band frequencies of 500c/s, 1000c/s and 2000c/s are of major importance. A vital concept in this connection is that of "noise exposure." Thus if the noise only occurs intermittently each day, a higher level can be permitted. The total time of exposure during a working life must also be considered.

To estimate the interference with speech communication, the noise rating number of the noise is determined for the octaves with mid-band frequencies of 500c/s, 1000c/s and 2000c/s. The expected intelligibility is indicated in the following table:—

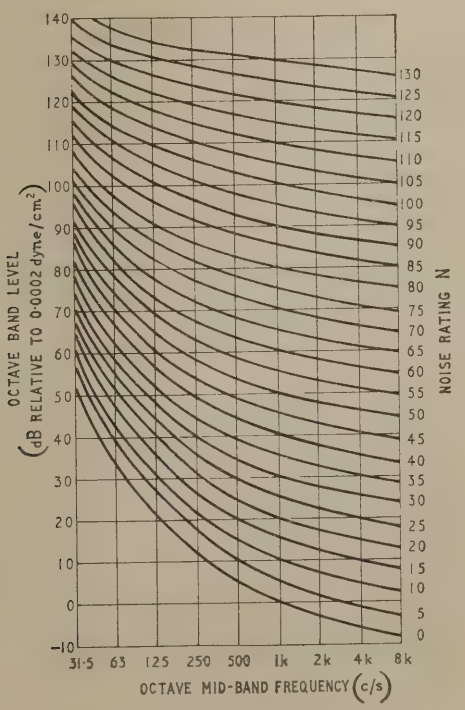


Fig. 7. Noise rating curves.

Noise Rating Number	Distance at which speech is intelligible	
	With normal voice	With raised voice
40	23ft	46ft
45	13ft	26ft
50	7ft	14ft
55	4ft	8ft
60	2ft 3in	4ft 6in

For rating with regard to annoyance, the noise rating number is first determined for the octave bands from 31.5c/s to 8000c/s. The noise can be considered annoying if the noise rating number exceeds an accepted criterion for the particular circumstances. Suggested maximum noise rating numbers inside schools, offices, workshops and other non-residential buildings are as follows:—

Noise Rating Number	Examples of type of room
20–30	Classroom, hospital, church, theatre, concert hall, small office, conference room.
30–40	Large office, laboratory, department store, quiet restaurant.
40–50	Larger restaurant, secretarial office, gymnasium.
50–60	Large typing pool.
60–70	Workshop.

In residential areas, basic noise rating criteria of 20-30 indoors and 30-40 outdoors have been proposed. Corrections are then made to allow for the type and duration of the noise, neighbourhood and similar factors which determine the annoyance of noise in the home. Typical corrections are as follows:—

1. Pure tone easily perceptible	.. ..	− 5
2. Impulsive and/or intermittent noise	.. ..	− 5
3. Only occurs during day time	.. ..	+ 5
4. Noise during 25% of time	.. ..	+ 5
6%	.. .. ..	+10
1.5%	.. .. ..	+15
0.5%	.. .. ..	+20
0.1%	.. .. ..	+25
5. Neighbourhood—quiet suburban	.. ..	− 5
—suburban	.. ..	0
—residential, urban	.. ..	+ 5
—urban near some industry		+10
—urban near heavy industry	.. ..	+15

The sum of the corrections in each section above is added to the basic noise rating to obtain a corrected criterion against which the noise rating number is compared.

A simpler method[16] of rating residential noise is based on sound level A instead of an octave analysis.

These noise rating procedures are largely empirical and the corrections and criteria will undoubtedly be revised as more experience is accumulated. However, they form a practical guide to the likely annoyance of a given noise situation.

Conclusions

The measurement and analysis of airborne noise is an extremely broad subject so that it has only been possible to outline some of the many problems. Noise is undoubtedly of growing importance and much work is still needed both on the fundamental mechanism of hearing, so that improved measuring techniques can be developed, and on methods for noise reduction.

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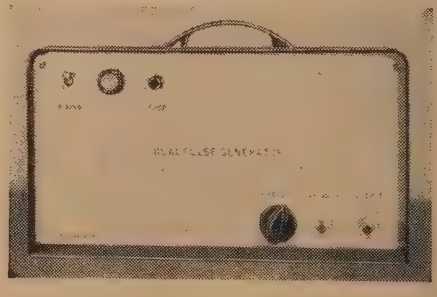
"Noise Measurement and Control," edited by P. Lord and F. L. Thomas (Heywood, 1963).

Dual Pulse Generator

THE ORBA Type 01 492 dual pulse generator provides accurate pulse trains for applications such as fault location, impedance end level and uniformity tests on coaxial cables. The instrument was designed to meet the requirement of the Post Office Engineering Department LW543 Specification.

Mains powered, the generator produces trains of +40V pulses at a p.r.f. of 15kc/s into 75Ω. The pulse widths taken at the pulse half-height are 100nsec and 200nsec respectively for alternative trains. Synchronous trigger pulses of 10V into 2kΩ are also available. The instrument, manufactured by Alexander Orba Ltd., Woolston, Southampton, costs £85.

4WW 419 FOR FURTHER DETAILS



Orba dual pulse generator.

INDUSTRIAL AND TECHNICAL FILMS

DURING the past few months we have received information on many new 16mm films and 35mm film strips from companies and film libraries. Here are details of a few which we feel may be of interest to colleges, schools, clubs, etc.

Further information on those films marked with an asterisk can be obtained from the Central Film Library of the Central Office of Information, Government Building, Bromyard Avenue, London, W.3, and on those marked with a dagger from the Rank Film Library, 1 Aintree Road, Perivale, Middlesex. The film titled "Analysis by Mass" is available from the A.E.I. Film Library, 33 Grosvenor Place, London, S.W.1. Incidentally, this film received first prize in the category on "the industrial applications of scientific principles and research" at the fourth International Film Festival, which was held in Madrid.

Except where otherwise stated, a hire charge is made.

Principles of the Optical Maser (V 640)*. In this 30-minute colour film Dr. C. G. B. Garrett, of Bell Telephone Laboratories, compares masers with standard radio oscillators and explains, with diagrams and lab. experiments, how the "photon chain reaction" is induced.

The Ultimate Speed—an exploraton with high energy electrons (V 646)*. An experiment in the Massachusetts Institute of Technology to determine the relationship between the kinetic energy of electrons and their speed forms the basis of this 38-minute film.

Analysis by Mass (on free loan from A.E.I.) describes the structure of atoms of elements, the combination of atoms to form molecules, and the use of a mass spectrometer to determine accurately the mass of an unknown molecule.

Similarities in Wave Behaviour (V 618)*. A lecturer explains the behaviour of waves using a mechanical wave simulator in this 27-minute Bell Telephone film.

The World of Semiconductors (UK 2230)*. Based on the I.E.E. 1961 Faraday lecture by L. J. Davies, of A.E.I., this 38-minute film (on free loan) deals with the properties, construction and uses of semiconductors.

The Printed Circuit Story (V 633)*. Several methods of producing printed circuit boards and techniques for servicing and repair are illustrated in this 25-minute colour film from the U.S.A.

Microminiaturisation of Electronic Equipment (UK 1707)*. This 28-minute colour film shows the techniques of making micro-components and assemblies. Originators: Royal Radar Establishment.

The 1500 Electronic Data Processing System.† This (free loan) 11-minute colour film gives an overall picture of the potential of the I.C.T. 1500 and deals specifically with three typical installations in small-, medium- and large-sized undertakings.

Memory Devices (V 619)*. The binary system, how binary information is stored, types of memory devices and their function in electronic computers are explained in this 27-minute Bell Telephone colour film.

Story of a Network.† This 20-minute film (on free loan) is centred on the building of a new television transmitter in the Presely mountains in South Wales and shows how the station fits into the national I.T.A. network.

I am going to be a Television Technician (UK 1733)*. The technical work entailed in mounting a television programme is shown in this 26-minute film. A lighting supervisor, a senior cameraman and a sound supervisor speak of their jobs, and a deputy technical controller describes the work of television engineers.

At Your Request (UK 1710)*. This 16-minute colour film shows the National Lending Library for Science and Technology in action. This library, which comes under the aegis of D.S.I.R. was opened last year and now has the largest scientific loan collection in Europe.

Ariel—the first International Satellite (V 637)* deals with the construction of Ariel and its equipment. The space experiments undertaken by the satellite are also mentioned in this 13-minute colour film.

FILM STRIPS

All the film strips listed below are in colour and have been prepared by the Mullard Educational Service and are available, priced at 25/- each with comprehensive teaching notes, from Unicorn Head Visual Aids Ltd., 42, Westminster Palace Gardens, London, S.W.1.

Electrical Meters and Measurement. This 28-frame film strip is in two parts. The first deals with the principles and construction of various types of meter movement and the second shows the correct approach to the use of measuring equipment.

Principles of Electrostatics. Most of the 28 frames are used in describing electrification, the structure of the atom, electrostatic induction, charge density, lines of force, and potential and capacitance. The film concludes with a description of various electrostatic machines and measuring devices.

Power Supplies for Communications. 32 frames are used to cover this subject. Among the items covered are rectifiers, filters, voltage stabilizers, multipliers, d.c. converters and e.h.t. units.

History of Magnetism. This 28-frame strip is the third in the series "History and basic principles" and outlines many of the early devices used to establish today's well-known principles of magnetism.

Detection and Detectors. After explaining the principles of detection and detectors, this 30-frame strip concludes with a number of amplitude-modulation detector circuits. This is one of a series which includes thermionic oscillators; amplification and amplifiers; and modulation and modulators.

INFORMATION SERVICE FOR PROFESSIONAL READERS

To expedite requests for further information on products appearing in the editorial and advertisement pages of *Wireless World* each month, a sheet of reader service cards is included in this issue. The cards will be found between advertisement pages 32 and 35.

We invite readers to make use of these cards for all inquiries dealing with specific products. Many editorial items and all advertisements are coded with a number, prefixed by 4WW, and it is then necessary only to enter the number(s) on the card.

Readers will appreciate the advantage of being able to fold out the sheet of cards, enabling them to make entries while studying the editorial and advertisement pages.

Postage is free in the U.K., but cards must be stamped if posted overseas. This service will enable professional readers to obtain the additional information they require quickly and easily.

JANUARY MEETINGS

Tickets are required for some meetings: readers are advised, therefore, to communicate with the secretary of the society concerned

LONDON

6th. I.E.E.—"Operational experience with wide-band radio links" by D. G. Jones at 5.30 at Savoy Place, W.C.2.

9th. Radar & Electronics Assoc.—"Medical automation" by Dr. L. C. Payne at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.

10th. Television Society.—"Managing a regional television station" by Nathan Hughes at 7.0 at I.T.A., 70 Brompton Road, S.W.3.

13th. I.E.E.—Discussion on "Getter ion pumps" opened by W. F. Gibbons at 5.30 at Savoy Place, W.C.2.

14th. I.E.E.—"Non-linear circuit theory" by Prof. J. C. West at 5.30 at Savoy Place, W.C.2.

15th. I.E.E.—"The quest for controlled thermonuclear reactions" by Dr. A. A. Ware at 5.30 at Savoy Place, W.C.2.

15th. Brit.I.R.E. — Three short papers on "Acoustical filters" at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

16th. I.E.E.—Five papers on "Waveguides" at 5.30 at Savoy Place, W.C.2.

17th. B.S.R.A.—"Magnetic tape specifications and performance" by G. Balmain at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2

22nd. Brit.I.R.E. & I.E.E.—"Noncanulated methods of measuring blood flow" by Dr. A. Guz and Dr. C. A. F. Joslin at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

23rd. Institution of Electronics.—"Microminiaturization of electronic components" by D. Boswell at 7.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

23rd. Television Society.—"An historical survey of band shared colour television systems" by I. Macwhirter at 7.0 at I.T.A., 70 Brompton Road, S.W.3.

27th. I.E.E. & Brit.I.R.E.—Colloquium on "The interconnection of peripheral equipment" at 2.30 at Savoy Place, W.C.2.

29th. Brit.I.R.E.—Papers on "Television receiver production techniques" at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

BIRMINGHAM

6th. I.E.E.—Discussion on "Training for the profession" opened by P. L. Taylor at 6.30 at the James Watt Memorial Institute, Great Charles Street.

15th. Television Society.—"The television studio—1: the camera" by H. Anstey at 7.0 at the College of Advanced Technology, Gosta Green.

23rd. Brit.I.R.E. — "Teaching machines" by Max Sime at 7.0 at Electrical Engineering Dept., University of Birmingham, Edgbaston.

27th. I.E.E.—"Electronics in railway signalling" by B. H. Gross at 6.0 at the James Watt Memorial Institute, Great Charles Street.

BRIGHTON

22nd. I.E.E.—"Synthetic speech and communication" by K. Holywell at 6.30 at the College of Technology.

BRISTOL

22nd. Brit.I.R.E.—"Ballistic missile early warning systems (BMEWS)" by G. G. Boyts at 6.30 at the University, Engineering Lecture Rooms.

27th. I.E.E.—"Semiconductor devices" by D. D. Jones at 6.0 in the Demonstration Theatre, Electricity House, Colston Avenue.

CARDIFF

8th. Brit.I.R.E. — "Stereophonic sound" by F. H. Brittain at 6.30 at the Welsh College of Advanced Technology.

CHELTENHAM

9th. Society of Instrument Technology.—"Vibration in the field of environmental testing" by S. C. Marks at 7.30 at the Belle Vue Hotel.

CHESTER

30th. Society of Instrument Technology.—"Solid state instruments for process control" by I. C. Hutcheon at 7.30 at the Stanley Palace, Watergate Street.

EDINBURGH

8th. Brit.I.R.E.—"Transistors in television receivers" by P. L. Mothersole at 7.0 at Department of Natural Philosophy, the University, Drummond Street.

14th. I.E.E.—"The present state of colour television" by S. N. Watson at 7.0 at the Carlton Hotel, North Bridge.

FARNBOROUGH

28th. I.E.E.—"Applications of superconducting" by A. C. Rose-Innes at 6.30 at the Technical College.

GLASGOW

9th. Brit.I.R.E.—"Transistors in television receivers" by P. L. Mothersole at 7.0 at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent.

13th. I.E.E.—"The present state of colour television" by S. N. Watson at 6.0 at the Royal College of Science and Technology.

31st. Society of Instrument Technology.—"Electronics versus pneumatics" by C. H. Gregory at 7.15 at the Scottish Building Centre, 425 Sauchiehall Street.

LEEDS

8th. Brit.I.R.E.—"A multi-function static switching system" by C. G. Cargill at 6.30 at the Department of Electrical Engineering, the University, Woodhouse Lane.

28th. I.E.E.—Discussion on "The New Ordinary National Certificate in engineering and its effect on training schemes" at 6.30 at the College of Technology.

LIVERPOOL

15th. Brit.I.R.E.—"Masers and lasers" by Dr. W. A. Gambling at 7.30 at the Walker Art Gallery.

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20th. I.E.E.—"Pulse techniques in line communication" by R. O. Carter at 6.30 at the Royal Institution, Colquitt Street.

LOUGHBOROUGH

21st. I.E.E.—"Recent developments in the theory of automatic control" by Dr. A. R. M. Noton at 6.30 in No. 1 Lecture Theatre, Union Building, College of Technology.

MALVERN

13th. I.E.E.—"Satellite communications" by F. J. D. Taylor at 7.30 at the Winter Gardens.

MANCHESTER

8th. I.E.E.—"Medical electronics" by W. J. Perkins at 6.15 at the Reynolds Hall, College of Science and Technology.

14th. I.E.E.—"Electronic summation metering" by M. L. Done at 6.15 at the Reynolds Hall, College of Science and Technology.

MIDDLESBROUGH

21st. Society of Instrument Technology.—"Some physical methods of analysis" by Dr. G. Jessop at 6.30 at the Cleveland Scientific & Technical Institution, Corporation Road. (Joint meeting with the Inst. of Physics and Phys. Soc.)

NEWCASTLE-UPON-TYNE

6th. I.E.E.—Discussion on "The computer and the electrical engineer" opened by Dr. E. S. Page at 6.30 at the Rutherford College of Technology, Northumberland Road.

8th. Brit.I.R.E. & Inst. of P.O. Elec. Eng.—"Some results of tests at the Goonhilly earth station" by F. J. D. Taylor at 6.0 at the Institute of Mining and Mechanical Engineers, Westgate Road.

20th. I.E.E.—"Storage tubes" by J. C. Firmin at 6.30 at the Rutherford College of Technology, Northumberland Road.

NOTTINGHAM

28th. I.E.E.—"Education of engineers" by Dr. E. R. Laithwaite at 6.30 in the Main Lecture Theatre, T1 First Year Applied Science Teaching Block, Nottingham University.

PORTSMOUTH

15th. I.E.E.—"Test equipment for the Armed Services" by F. W. Jackson, E. Booth and D. F. Cockram at 6.30 at the College of Technology.

SHEFFIELD

29th. I.E.E.—"Some aspects of the use of computers in process control applications" by J. F. Roth at 6.30 at the University, Mappin Street.

SOUTHAMPTON

7th. Brit.I.R.E.—"Solid state switching" by A. C. Savage at 6.30 at the Lanchester Theatre of the University of Southampton.

14th. I.E.E.—"An introduction to programming languages" by M. J. Kingston at 6.30 at the University.

WEYMOUTH

16th. I.E.E.—"Recent developments in components for computers" by W. Renwick at 6.30 at the South-Dorset Technical College.

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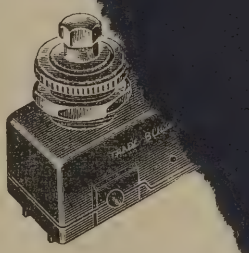
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must be some subtle difference between the meanings of the Latin words ultra and super of which I am ignorant.

I am not a Latin scholar myself nor have I ever claimed to be. I might possibly have become one but when I was studying Latin, among other things, Kitchener pointed his accusing finger at me in the famous recruiting poster and said that "Your Country Needs YOU." I recall thinking at the time that the country must be in a pretty parlous plight if Kitchener seriously thought my services in his famous army could affect the issue.

However, I decided to trust his word and so laid aside my "Lewis & Short" and my "Liddell & Scott"; but Kitchener got tired of me after a few months, and I found myself in a loathsomely instable ship, hoping that a kindly U-Boat commander would soon end my misery. *Sic transit spes mea docti.*

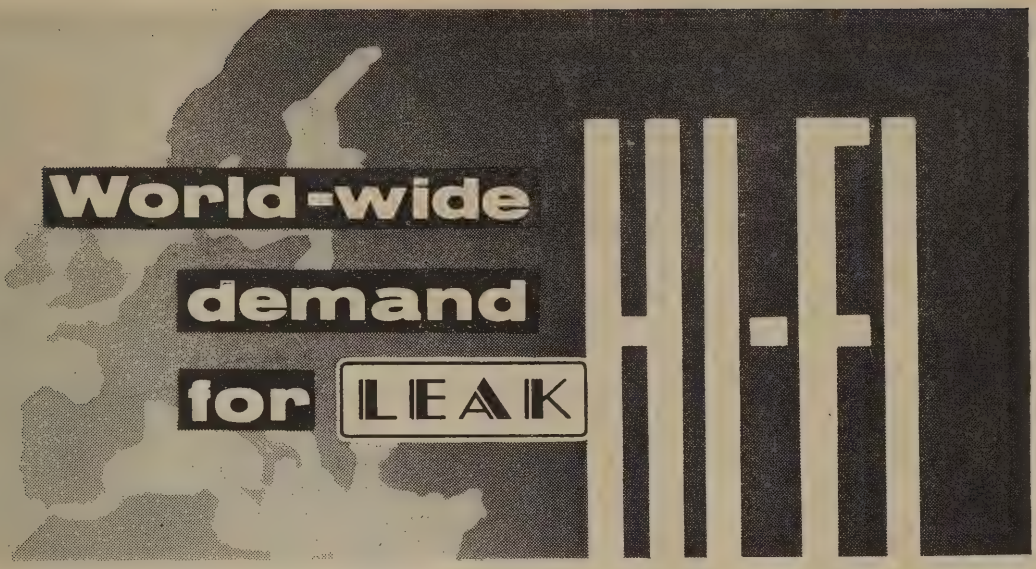
I do, therefore, ask you who were too young to be beguiled by Kitchener to enlighten my ignorance as to why ultrasonic waves are not called supersonic ones because they are, after all, just as much above audibility as are the supersonic beat frequencies handled by our i.f. amplifiers. No doubt there is some niggling nuance of meaning which makes the two words non-interchangeable.

Queen Victoria's Set

THE letter from Mr. Rowland F. Pocock in the December issue—and also the one in the November number—about the origins of wireless in the R.N. interested me greatly. He certainly seemed to know what he was talking about and took the trouble in his latter letter to make good some omissions in his former one. I wonder if it was the R.N. who fitted wireless to the Royal Yacht *Osborne* and also to the Queen's residence at East Cowes in 1898?*

For the benefit of the younger readers of *W.W.* who may not realize that wireless is so old, I had better explain that Queen Victoria did not have wireless fitted because she was seeking to be amused, which history tells us would have been rather difficult to accomplish. She had the installation fitted in order to keep in touch with the Prince of Wales ($2\frac{1}{2}$ years later, King Edward VII) when he was carrying out a leisurely circumnavigation of the Isle of Wight while convalescing. It seems a pity that the installation did not find its way to the Science Museum. Maybe it did and the curators have it stored away waiting for the opening of the new block.

* Mr. Marconi was requested to set up the land station at Ladywood Cottage, Osborne.—ED.



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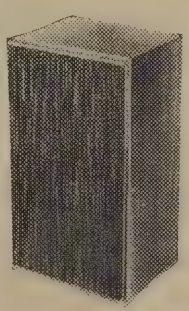

Right: *The new Leak "Sandwich" loudspeaker System with the new "Sandwich" Cone gives, for the first time in history, a direct-radiator loudspeaker diaphragm which behaves in the theoretically ideal manner of a rigid piston and reproduces the signal applied to the speech coil without flexing and free of break-up distortions.*
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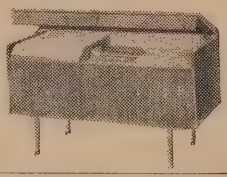

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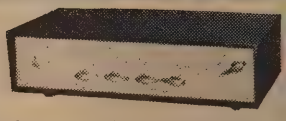
BY FAMOUS BRITISH MANUFACTURER



Self-contained integrated stereo amplifier, including combined control unit pre-amplifier. Designed to provide high quality stereo and mono reproduction with a rated output of 6 watts per channel stereo, 12 watts mono. Input sockets are provided for the direct connection of most types of tuners and pick-ups, plus tape heads and high quality microphones including moving coil and ribbon. Separate output for feeding a tape recorder available on each channel. Facilities include inputs for Mic. 5 m/v.; tape 4 m/v.—equalised for CCIR; RIAA. 4.3 m/v; flat 250 m/v; radio tuner 100 m/v. Overall response 60 cycles—20,000 cycles. Controls fitted are bass, treble, balance, volume, phase reverse, stereo sense and selector. Outputs 4, 8 and 16 ohms. Mains voltage 105-240 v. A.C. Attractively styled in free-standing metal case, finished in silver and black. Size: 14 × 8 × 4 inches. Suitable for use with any good quality tuner, speaker system, record player, etc. Will form the basis of a high fidelity stereo system. Brand New and Unused in maker's original cartons.

LASKY'S PRICE £15 Carriage & Packing 7/6.

HI-FI 'TWENTY'

20 watt amplifier with integrated pre-amp/control unit. Valve line-up: E.F.86, E.C.F.80, 2-EL 34 and metal rectifier. Size: 12in. × 9in. × 5in. High and low gain inputs with a separate volume control for each. Bass and treble controls fitted. 15 ohms output. Socket with spare H.T. and L.T. for tuner, etc. An excellent amplifier for guitar and P.A. work.

LASKY'S PRICE £14.19.6 Carr. & Pkg. 7/6.

'LINEAR" AMPLIFIERS
"Diatonic" 10-14 watt.. 12 Gns.
"Concord" 30-watt .... 16 Gns.
L45, 4-5 watt £5 19 6
LT45 Tape Deck Amp. .. 12 Gns.
L10 10-watt with pre-amp. ..... 15 Gns.
L50 50-watt ..... 22 Gns.
L5/5 Amplifier and Pre-amp. ..... 12 Gns.
LP1 Tape Pre-amp. .... 9 Gns.

ARMSTRONG EQUIPMENT
A.F.208, £21/4/-.
Model 227M £33/18/-.
Stereo 55 £29/18/-.
Model227 £48/15/-.
Model 226 £56.
Model 222 Amp. £27/10/-.
T.4.c. £17/19/-.
T.4.b. £20/8/-.
S.T.3. Mk. II £25/12/-.
A.20 Stereo Amp. £23/12/6.
P.C.U. 25 Stereo Pre-Amp. £21.

CELLULOSE WADDING For lining the interior of loudspeaker enclosures. Width 36in. Any length cut to nearest 6in.
LASKY'S PRICE 2/11 per sq. yd. P & P. extra. and pro-rata.

BONDED ACETATE FIBRE as recommended by Wharfedale for acoustic lagging 36in. wide **5/11** per sq. yd. and pro rata. P. & P. extra.

COMPLETE SYSTEMS

PRIVILEGE PARCELS

A "Privilege Parcel" allows you to purchase the Audio System of your choice at a worth-while cash saving. Some examples are listed below, but we shall be pleased to quote our "Privilege Parcel" Prices for any selection of equipment of your own choice. Send us details of your requirements.

Tudor Stereo Amplifier	£15 0 0
Connoisseur Craftsman, 2-speed transcription player	£16 6 6
Decca FFSS Stereo Pick-up	£18 18 0
Total	£50 4 6
"Privilege Parcel" Price	£47/10/-.

Tudor Stereo Amplifier..	£15 0 0
Braun PC4L Stereo Transcription Unit	£12 9 6
2x Sharon Loudspeaker Systems	£19 19 0
Total	£47 8 6
"Privilege Parcel" Price:	£45.

Collaro Studio Tape Deck ¼ track model	£10 10 0
Lasky's Tape Amplifier ..	£8 19 6
Portable Case	£3 15 0
7 × 4in. speaker	15 6
Total	£24 0 0
"Privilege Parcel" Price:	£22/10/-.

Collaro Studio Tape Deck, ¼ Track Model	£13 19 6
Martin Tape Amplifier, ¼ track model	£12 12 0
Portable Case with Speaker.....	£5 5 0
Total	£31 16 6
"Privilege Parcel" Price:	£30.

Carriage and Packing on all the above parcels, 10/6 extra.

LASKY'S FOR ALL TEST GEAR & TECHNICAL ADVICE

4WW—103 FOR FURTHER DETAILS.

udio Equipment & Components

& TAPE RECORDERS

THE FINEST RANGE OF MONO/STEREO STUDIO AND TRANSISTORISED PORTABLES

LASKY'S RADIO

TRANSISTORISED

THE "TRAV-LER"

PORTABLE TAPE RECORDER

Dimensions: 10×8×5in., weight 9lb. Speed 3¾in. per sec. Wow and flutter better than .4 r.m.s. Battery life 50 hours. Amplifier 400 mW Uses 6 Mullard transistors. Speaker: 3 ohm High-flux, 7×4in. Playing time 44 min. using 3in. spools double play tape. Rewind time 2½ min. Neon record level indicator, pause control, loudspeaker switch. Can be run off mains power. Socket for external power supply. With Lustraphone LD66 moving coil microphone, 540ft. tape and spool. Brand new and in original maker's cartons. List price £30/9/-.

SPECIAL REDUCTION

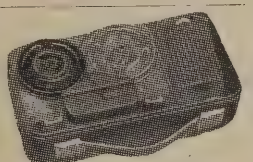
LASKY'S PRICE 13 GNS.

A.C. mains unit available **39/6.** Post 3/6. *Carr. & Ins.* 17/6

The "CLARION" PHONOTRIX

A fully transistorised battery operated recorder. With leather case. Carr. 7/6.

LASKY'S PRICE 16 GNS.



Very Latest "PHONOTRIX"

with push-pull output. Carr. 7/6.

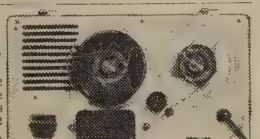
LASKY'S PRICE 20 GNS.

Full details of these Recorders, see previous adverts.

CLARION "TWINSET"

Transistor amplifier with 7in.×4in. speaker in a portable case. The Clarion Phonotrix recorder can be housed in the case with the amplifier, this giving full quality output. Listed at 8 gns. **LASKY'S PRICE 7 GNS.** P. & P. 5/-.

The *Conet*



Fully transistorised 2 speed Battery Tape Recorder. This is a high quality machine incorporating features usually found in machines 3 times the price. ● Capstan drive. ● 2 speeds, 3¾ and 1⅞ i.p.s. ● Rec. level meter. ● Fast re-wind. ● All-metal case. ● Uses standard pen torch batteries with easy load containers. ● Twin tracks. ● 2½in. speaker. ● Accessories included: Real Leather carrying case, Microphone, Telephone adaptor, Personal earphone. Remote switch control available.

A REALLY SUPERB RECORDER BRAND NEW & UNUSED

LASKY'S PRICE 19 GNS.

Optional Extras. Remote Control Mic. **35/-.** Remote Control Foot Switch **25/-.**

CONSTRUCTORS BARGAINS

BUILD A HIGH QUALITY TAPE RECORDER

Using the famous Collaro "STUDIO" deck and MARTIN pre-assembled amplifiers 2 or 4 track models.

COLLARO STUDIO TAPE DECK

Latest model. 3 speed, 3 motors. Take 7in. reels. Fitted with half-track heads. **LASKY'S PRICE £10/10/-.** New and Unused. Carr. and Pack. 7/6.

COLLARO STUDIO TAPE DECK. As above but fitted with the latest quarter-track heads. **LASKY'S PRICE £13/19/6.** Carr. and Pack. 7/6.

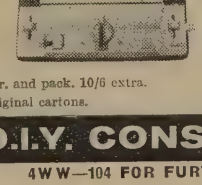
MARTIN TAPE RECORDER AMPS. Designed for use with Collaro Studio Tape Deck. In sub assemblies for immediate installation. 6-valve circuit. Comprehensive instructions make final assembly as simple as possible. Everything supplied, including valves, etc. Monitoring facilities. 3-ohm output, speed equalising, etc. For 200-250 v. A.C. mains.

PRICE ¼-track Model **£11/11/-.** ½-track Model **£12/12/-.** P. & P. 2/6.

Portable carrying case designed to take the Collaro studio tape deck and the Martin tape amplifier. Fitted with 9in. × 5in. speaker. Price complete with speaker **£5/5/-.** P. & P. 5/-.

See Special Privilege Parcel offer

FIRST TIME AVAILABLE TO THE HOME CONSTRUCTOR



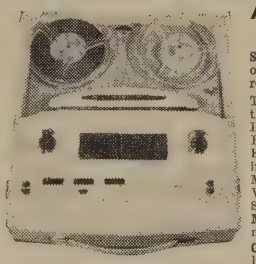
The latest E.M.I. tape deck. Four tracks: 2 speeds 3¾ and 7½ i.p.s., 3 motors, clock position indicator. Full facilities for 4 track stereo and mono. Frequency response 30-20,000 c/s. at 7½ i.p.s. 3dB. Wow and flutter <0.15% at 7½ i.p.s. For 200-250 volt 50 c.p.s. Mains capstan drive, fast forward and fast re-wind. Unit plate size 13¾×12½in. depth below top of plate 3¾in. Takes 7in. diameter spools. Pause control.

Today's list value 28 gns.

LASKY'S PRICE £17.19.6 Carr. and pack. 10/6 extra.

Brand new and unused in makers' original cartons.

HUGE PURCHASE OFFER



All Brand New and Unused, in perfect working order.

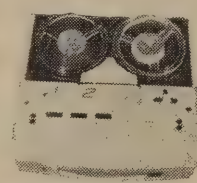
Supplied complete with crystal microphone, reel of tape and empty spool, also screened lead for recording from radio, pick-up, etc.

The following specifications are common to all three models: Tone Control Visual Recording Indicator. Inputs: Microphone, Radio, Record-Player, Radiogram, Telephone Adaptor. Fully Automatic Erase. **Facilities:** Fast spooling, forward and reverse. **Valves:** Latest Mullard Miniature types. **Rectifier:** S.T.C. or Westinghouse Metal Rectifier. **Loudspeaker:** Standard 3 ohm with extension speaker socket. **Microphone:** new super sensitive crystal in the new easy to hold microphone case.

Carrying Case: Portable case with detachable lid, harmonising gold trim and automatic safety locks. Storage cubby for microphone and accessories covered in. New type washable scratch resistant Vinyl.

Size for Models A and B: 14½×14×6½in. Size for Model C: 14×12½×6½in.

MODEL A Studio Deck, Four Track. Speeds: 1⅞, 3¾ and 7½ i.p.s. Spool capacity: 7in. Wow and Flutter: Less than 0.15% total. Playing Times: up to 18 hours. Frequency Response: 12,000 c.p.s. at 7½ i.p.s. Mains Voltage: 200-250 v. 50 c/s A.C. Output 3 watts.



LASKY'S PRICE 27 GNS.

Carriage & Insurance 15/- extra.

MODEL B STUDIO DECK, TWO TRACK

Specification as for Four Track model above, except that this is fitted with Two Track Studio Tape Deck. Maximum Playing Time up to 9 hours from one reel of tape.

LASKY'S PRICE 25 GNS.

Carriage & Insurance 15/- extra.

MODEL C Fitted with B.S.R. Deck, two-track version. Specification: Single speed, 3¾ i.p.s. Freq. response 10,000 c.p.s. at 3¾ i.p.s. Spool capacity: 5½in. Mains Voltage: 200-250 v. 50/60 c/s. A.C. Wow and Flutter: Less than 0.2% total. Output: 3 watts. Playing time: up to 3 hours.

LASKY'S PRICE 18 GNS.

Carriage and Insurance 15/- extra.

THE "MINY" A self-contained Transistor Battery Recorder. Size only 8×7½×2½in. Weight 3½lb. Takes 3in. spools, twin track, 3¾ i.p.s. With tape, mic. and batteries.

LASKY'S PRICE 7½ GNS. P. & P. 5/-.

TAPE DECK MOTORS

Motors for the Collaro Studio Deck—new and unused. 200-250 v. A.C. Take-up; rewind and capstan. Listed at £2/5/- each. **LASKY'S PRICE 14/11 each.** P. & P. 2/6. Set of 3 **35/-.** P. & P. 6/-.

ACOS CRYSTAL STICK MIC. Type MIC.39/1, complete with Cable. List £5/5/-. **LASKY'S PRICE 32/6.** Post free.

Crystal Hand or Table Mic. **15/-.** Post free.

LAPEL TYPE MP110. High imp. xtal mic. 1⅛in. dia.×⅜in. thick **15/-.** Post 1/-.

TYPE NP100. Tie clip mic., 1×⅝×⅜in. High imp. xtal, **22/6.** Post 1/-.

BRENELL TAPE EQUIPMENT

All BRENELL Tape Equipment stocked: Mark V Series II Tape Deck from **31 gns** Mark 510 Series II Tape Deck from **43 gns.** Mark V Series II Record/Play Amp. from **£26.** Mark V Series II Tape Recorder, **69 gns** Mark V Series II Tape Recorder with meter **75 gns.**

S.T.B. 1/5/2 Recorder. **£120.**

TAPE FULLY GUARANTEED AT RECORD LOW PRICES

Famous make. P.V.C. base on latest type plastic spools. New, perfect, boxed, guaranteed.	1,200ft. on 7in. spool	15	0
	1,800ft. on 7in. spool	19	6
	1,200ft. on 5½in. spool	17	6
	850ft. on 5½in. spool	11	6
All other makes, types and sizes of tape in stock including E.M.I. and Scotch.	600ft. on 5in. spool	11	3
	225ft. on 3in. spool	4	11
	2,400ft. D.P. on 7in. spool	32	6

1,800FT. ACETATE TAPE on 7in. reel by famous American manufacturer. **15/-.** Post and Pkg. 1/-.

HI-FI TAPE RECORDER HEADS

High Impedance Record Play. Low impedance erase. Upper or lower track.

State track required when ordering.

LASKY'S PRICE 29/6 Post free Per pair

MARRIOTT "X" Type ¼ track heads, Record/play and erase **4 GNS.** pair.

¼ Track heads record/play and erase **59/6** pair.

LASKY'S FOR D.I.Y. CONSTRUCTION BARGAINS

P.T.O. FOR MORE NEWS

4WW—104 FOR FURTHER DETAILS.

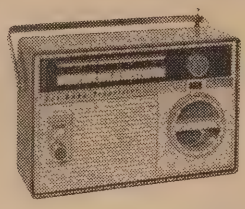
LASKY'S RADIO

For The Finest Value an

TRANSISTOR RECEIVERS &

THE WIDEST RANGE AVAILABLE TODAY FOR HOME CONSTRUCTION OR READY BUILT TO HIGHEST STANDARDS

We consider our Construction Parcels to be the finest value available on the home construction market. If on receipt you feel not competent to build the set, you may return it as received within 7 days, when the sum paid will be refunded less postage.



The SKYROVER

Controls: Waveband Selector, Volume Control with on/off Switch. Tuning Control. In plastic cabinet, size 10 × 6½ × 3½in. with metal trim and carrying handle.

Can be built for

£10 . 19 . 6

Post & Pkg. 5/- extra.

LASKY'S FIRST AGAIN!

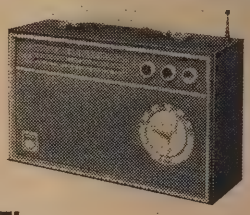
Now offer to the Home Constructor —full short wave coverage with

THE SKYROVER & THE SKYROVER DE LUXE

GENERAL SPECIFICATION:
7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 torch batteries.
The SKYROVER and SKYROVER DE LUXE covers the full Medium Waveband and Short Waveband 31-94 M, and also 4 separate switched band-spread ranges, 13M, 16M, 19M and 25M, with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow, stage by stage instructions.

SPECIFICATION:
Superhet, 470 Kc/s.
Uses 4-U2 batteries.
Easy to read Dial Scale.
500 MW Output.
All Mullard Transistors and Diode.
5in. Ceramic Magnet P.M. Speaker.
Band Spread Tuning.
Telescopic Aerial and Ferrite Rod Aerial.

WAVEBAND COVERAGE: 180-576M; 31-94M and Band Spread on 13, 16, 19 and 25 metre Bands.

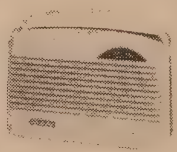


The SKYROVER de luxe

Tone Control Circuit is incorporated, with separate Tone Control in addition to Volume Control, Tuning Control and Waveband Selector. In a wood cabinet, size 11½ × 6½ × 3in. covered with a washable material, with plastic trim and carrying handle. Also car aerial socket fitted.

Can be built for **£12.19.6** P. & P. 5/- extra.

Data for each receiver: 2/6 extra. Refunded if you purchase the parcel. Four U2 batteries, **2/8** extra. Four Leak-Proof batteries, **3/4** extra. *All Components Available Separately.*



REALISTIC SEVEN

Fully tunable long and medium bands. Uses 7 Mullard Transistors; plus Diode OA70.

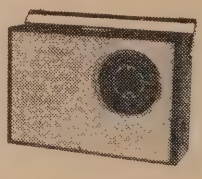
STAR features:
★ 7 Transistor Superhet. ★ 350 Milliwatt output 4in. high flux speaker. ★ All components mounted on a single printed circuit board, size 5½in. × 5½in. in one complete assembly. ★ Plastic cabinet, with carrying handle, size 7in. × 10in. × 3½in., in blue/grey. ★ Easy to read dial ★ External socket for car aerial. ★ I.L.-frequency 470 Kc/s. ★ Ferrite rod internal aerial. ★ Operates from PP9 or similar batt. ★ Full comprehensive data supplied with each Reciver. ★ All coils and I.F.s, etc., fully wound ready for immediate assembly. An outstanding Receiver.

Can be built for

£5 . 19 . 6

P. & P. 4/6

REALISTIC SEVEN DE LUXE



By popular request a De Luxe version of the well-proven Realistic Seven now available. With the same electrical specification as standard model— PLUS A SUPERIOR WOOD CABINET IN CONTEMPORARY STYLING covered in attractive washable material, with superchrome trim and carrying handle. Also a full vision circular dial, externally mounted to further enhance the pleasant styling. ALL FOR ONLY **£1** EXTRA. Battery **3/9** Extra. (All components available separately.) Data and instructions separately **2/6**, refunded if you purchase parcel.

THE SPRITE

★ 6-Transistor Superhet Mini Personal Pocket Radio. ★ Long and Med. wavebands. ★ Uses PP3 batt. ★ Ferrite Rod aerial. ★ I.F. Freq. 470 Kc/s. ★ 3in. speaker. ★ Printed circuit 2½in. × 2½in. ★ Slow motion Drive. ★ Plastic case, size 4in. × 2½in. × 2in.

In order to ensure perfect results, the SPRITE is supplied to you with R.F. and I.F. stages. Driver and Output stages, ready built with all components ready mounted on the printed circuit. The SPRITE pre-assembled plus cabinet, speaker and all components for final construction. **CAN BE BUILT FOR 79/6.** Post and pack. 3/6 extra. Data and instructions separately, **2/6.** (Refunded if parcel is purchased.) **Real calf leather case, wrist strap, personal earphone, case for earphone and battery. 12/6** the lot extra.

CAN BE BUILT FOR

79/6

P. & P. 3/6 extra.

Make no mistake—this is a SUPERHET receiver of genuine commercial quality. It is not a regenerative circuit.

LASKY'S CAR RADIO

Superhet 470 Kc/s. I.F. with Tuned R.F. stage 12 v. operation. Transistor output. Medium and Long waves. Permeability tuning. T.C.C. Printed Circuit. Small size, will fit any car.

CAN BE BUILT COMPLETE WITH SPEAKER FOR £9/19/6. Post 3/6 Booklet **2/6** (refunded if you order).

READY BUILT

BOYS TRANSISTOR RADIO

2 transistor pocket radio. In attractive plastic case. Size only 4in. × 2½in. × 1in. Fitted with 2½in. loudspeaker. Socket for personal earpiece and telescopic aerial. Works from single PP3 type battery. Fully tunable over full medium waveband. Supplied complete with earpiece, telescopic aerial, carrying purse and 9-volt battery. Ideal Birthday or Christmas Present.

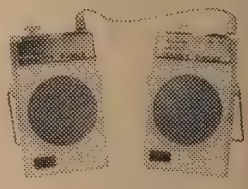
LASKY'S PRICE 42/- POST FREE with all accessories.

6 Transistor pocket radio fully built, in plastic case, 4in. × 2½in. × 1in. with 2½in. speaker. Uses single PP3 type battery. Supplied complete with personal earpiece and leather case. Tunable over full medium waveband.

LASKY'S PRICE 79/6 P. & P. 2/6. complete with all accessories.

FULLY TRANSISTORISED

INTERCOM/BABY ALARM



In 2 compact units, each size 4in. × 2½in. × 1in. Internal loudspeakers give ample volume. Complete ready for immediate use. Works from PP3 battery.

Complete with battery and sixty feet of connecting wire.

LASKY'S PRICE 69/6

P. & P. 2/6.

THE RAINBOW INTERCOM

A high powered 2 station intercom—ideal for shops, offices, etc.

LASKY'S PRICE £6.19.6. P. & P. 3/6.

THE PETIT FULMITER

Designed to replace PP3 9v. battery. Operates direct from 200-250 A.C. Same size as PP3. **18/6.** P. & P. 1/6.

TRANSISTOR AMPLIFIERS

SUB-MINIATURE

NPN-PNP Transformerless. Smallest ever, size 1in. × 1in. × 1in. Output 125 MW from 9 v. batt. Output impedance 30-60 ohms. Freq. range 100 cycles, 25 Kc/s. Uses 3 transistors. Single-ended push-pull output. Fully assembled on printed circuit with full data and instructions, **29/6** complete, post 2/6.

300 m/w OUTPUT AMPLIFIER

Uses 2 OC71 and 2 OC72. Vol. and tone controls. Fully assembled, size 3 × 2 × 2in., **39/6.** Post 2/6. Knobs 3/6 extra. Speaker 30 ohm 5 inch. Matched to amplifier **25/-.** Post 1/6

P.T.O. FOR MORE NEWS

LASKY'S FOR SPEEDY MAIL ORDER SERVICE

4WW—105 FOR FURTHER DETAILS.

ervice in Great Britain

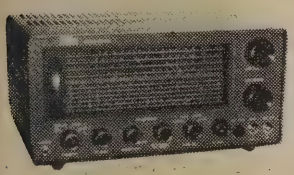
ONSTRUCTORS BARGAINS

HUGE STOCKS OF COMPONENTS, TEST GEAR, ETC.
SPEEDY MAIL ORDER SERVICE

LASKY'S RADIO

MODEL 9R59

BRAND NEW AND UNUSED
COMMUNICATION RECEIVERS

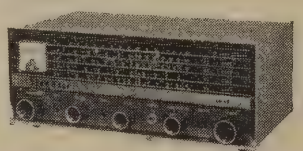


Incorporating all the latest technical achievements with many exclusive features. Covers range from 540 Kc/s. to 30 Mc/s. Ham Band is provided with a scale for direct reading, and can also be band spread. Auxiliary circuits fitted are automatic noise limiter A.V.C. and M.V.C. Q Multiplier also serves as B.F.O. H.F. stage and two I.F. stages ensure high sensitivity and selectivity. Valve line up 3 × 6BA6, 2× 6BE6, 2 × 6AV6, 1 × 6Q5 and 5Y3. 2 Aerial Sockets. Stand by position for use with a transmitter. S meter fitted. 200-250 v. A.C. mains. Controls fitted are function switch, volume control, selectivity control, frequency control, band selector, gain control, aerial trimmer AVC/MVC switch, noise limiter switch, band spread tuning and main tuning. Brand new and unused. Boxed with full instruction manual, in attractive steel cabinet, grey crackle finish. Cabinet size 15 × 8 × 10in. Dial 12 × 4in.

LASKY'S PRICE 40 GNS.

Carriage and Packing Free.

MODEL SR40



Covers medium wave band and 1.6-4.4 Mc/s., 4.5-11.0 Mc/s. 11.0-30.0 Mc/s. in separate switched band spread ranges. Controls include B.F.O. Sensitivity, A.N.L., Receiver-Standby Switch, Tone Switch. S-Meter. For 200/250 v. AC/DC. Internal loop and telescopic antennae fitted. Valve line up. 12BE6, 12BA6, 12AV6, 50C5, and metal rectifier. Size 13½ × 8½ × 5½in.

LASKY'S PRICE £24.15.0

Carr. and Ins. 15/-. Instruction manual included.

EMI 4-SPEED RECORD PLAYER

New, unused and individually boxed fitted with lightweight pick-up with ACOS G.P. 73/2 stereo cartridge. Cabinet space required 13½ × 12½ × 4½in. A 9in. metal turntable is fitted. For use on 200/250 volt A.C. Mains, with Auto-stop. The stereo cartridge will play all types of Mono Records, 78's, L.P.s etc., but if desired a G.P. 67 LP/78 Mono cartridge will be supplied in lieu of the GP73 at no difference in cost.

LASKY'S PRICE 79/6 P. & P. 3/6.

STAAR KINDER RECORD PLAYER

45 r.p.m., 6 v. Batt. operated. Complete with pick-up fitted crystal cartridge. Size only 7½ × 6in. Fitted auto. stop and start. New and perfect.

LASKY'S PRICE 49/6 P. & P. 2/6.

2-speed model for 33⅓ and 45 r.p.m. 79/6. P. & P. 2/6

CRYSTAL PICK-UP CARTRIDGES

LOWEST PRICES EVER!

All Complete with Styli L.P. and Standard (and Stereo where shown) fully guaranteed, Standard Fitting will fit most P.U. Arms and Heads. Postage 1/- extra each.

MONO Type C.T.1. By well-known manufacturer With 2 sapphire styli	9 6
Garrard Ceramic G.C.E.4	15 0
Garrard Magnetic T.O.M.2	15 0
Acos GP.59	14 0
Acos GP.66/3	15 0
Acos GP.65/1	17 0
Acos GP.67/1	14 0
STEREO Acostereo 73/1, with 2 sapphires	25 0
Acostereo 73/2, with Diamond LP/Stereo and sapphire Std.	29 6
Collaro type C Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with Diamond L.P./Stereo and sapphire Std.	25 0
Ronette Stereo O.V. Turnover, with 2 sapphires	25 0
Ronette Stereo type 105 and 106 with 2 sapphires	35 6
Ronette Stereo type 105 and 106 with Diamond LP/Stereo and sapphire Std.	39 6

BUILDING YOUR OWN RADIOGRAM? *Then Don't Miss These Special Offers*

"ORION" RADIOGRAM CHASSIS. Long, medium and short wave bands. 6 valve circuit. Piano key selection. Pick-up and speaker sockets. Size 13½ × 9½ × 7in Volume and tone controls. With 9 × 5in. speaker. **LASKY'S PRICE £10/19/6.** Carr. and pack. 12/6 extra.

TUNER CHASSIS.
A factory built FM Tuner using the Gorler front end unit and I.F.s. Freq. range: 88-108 Mc/s. Valve line-up: 6AL5; 3×6AU6; ECC85. Fully assembled on printed circuit. Illuminated glass dial. Overall size 12×5×3 in. Unpowered—requires 6.3v.L.T. and 200v. at 40 m/a H.T. Full circuit data included. **LASKY'S PRICE £5/19/6.** Post and Pkg. 6/-.

SPECIAL AMPLIFIER OFFER

Verdick "Quality Ten" Hi-Fi amplifier and pre-amplifier. Listed at £21.
LASKY'S PRICE £14/19/6. Post and Pkg. 7/6.
VERDICK MK. III with "High-Gain" Pre-Amplifier. 15½ gns. Post and pkg. 7/6.
VERDICK Mk. V amp. and pre-amp. 15½ gns. Post and Pkg. 7/6.

We stock a complete range of...
A.M./F.M. RADIOGRAM CHASSIS and TUNERS—of ALL MAKES

ELECTRIC MOTORS

Brand new tape recorder motors' Single phase, fully shrouded. 200-250 v. A.C. ⅝ × ½in. spindle with detachable pulley, fitted switch. Suitable for tape decks, record players and many other uses. 14/11. P. & P. 3/6.

LASKY'S PRICE 7/11

DISTLER MINIATURE MOTORS

6 volt battery operated

LASKY'S PRICE 7/11 P. & P. 2/6.

ADASTRA 3-3 AMPLIFIER

Adastra 3-3 amplifier. Three watt output, built to the well known 3-3 design with volume bass and treble controls. Size 9in. × 7in. × 4in. With attractive escutcheon. Ready built.

LASKY'S PRICE £4.19.6 P. & P. 5/-.

A.K.G. Moving coil stereo headphones. Lightweight with ear pads. **7 GNS.** per pair.

FOSTER Stereo moving coil headphones. **79/6** including ear pads. P. & P. 2/6 pair extra.

TRANSISTORS

All NEW and GUARANTEED

GET S1, GET S5, GET S6 **2/6**; 837A, 874P **3/6**; OC 45, OC 71, OC 81D **4/6**; OC 44, OC 70, OC 76, OC 81 (match pair **10/6**) **5/6**; AF 117, OC 72, OC 75, OC 170, OC 171, OC 200 **6/6**; OC 25, OC 42, OC 43, OC 73, OC 82D **7/6**; OCP 71 **9/6**; OC 28, OC 201, OC 204 **15/-**; OC 205, OC 206 **19/6**.

TRANSFILTERS

by BRUSH CRYSTAL Co. Available from stock.

TO—O1B	465	kc/s.	± 2	kc/s.	**6/6 EACH** P. & P. 6d.
TO—O1D	470	kc/s.	± 2	kc/s.	
TO—O2B	465	kc/s.	± 1	kc/s.	
TO—O2D	470	kc/s.	± 1	kc/s.	
TF—O1B	465	kc/s.	2	kc/s.	
TF—O1D	470	kc/s.	2	kc/s.	

T.V. TURRET TUNERS

Famous British make 38 Mc/s. I.F. with a few coils. Uses PCC84 and PCF80 valves. Less valves **LASKY'S PRICE 5/-.** P. & P 2/-. (No data or circuit available.)

MULTI TEST METERS

All new and unused and complete with test leads. The finest imported makes, also by AVO, TAYLOR, etc. Write for FREE LIST.

MINIATURE EARPIECES

for Transistor Radios. Transparent ear-inserts with 3ft. cord. sub-min. jack and socket. Fully guaranteed. Post free.

OR.5. Crystal high imp.	5 0
MR.4. Magnetic low imp. Post free	6 6

AUTOMATIC CAR AERIALS

Electrically operated automatically extends and retracts at touch of a button. Opens to 72in. Easily fitted. Heavy chrome plated. 12 volt only. **LASKY'S PRICE £6/19/6.**

SEND FOR OUR LATEST COMPONENT CATALOGUE
Complete new edition of over 100 pages, 8½ × 5½in., copiously illustrated, packed with money-saving bargains. Invaluable for the "ham" or service man. **Price 2/-.** Post 6d. Our latest 20-page "Bargain Bulletin" included free (separately by post, 6d.).

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STERN-CLYNE

INCORPORATING STERN RADIO LTD., PREMIER RADIO, CLYNE RADIO LTD.

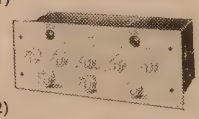
★ STEREO AMPLIFIERS ★

(1)

(1) MULLARD "10 Plus 10" STEREO AMPLIFIER.

A High Fidelity design providing up to 10 watts (per channel). Superb reproduction. Frequency response flat to within 3 dB from 3 c/s to 60 Kc/s at 50 mW. Total harmonic distortion at 10 watts 0.1%. Built to the highest technical standards and presented strictly to MULLARD'S Specification. Two specially designed GILSON ULTRA LINEAR OUTPUT TRANSFORMERS with 20% taps are used.

KIT OF PARTS **£20.0.0** BUILT AND TESTED **£24.0.0** (C. & I. 7/6.)



(2)

We can also supply the **MAIN AMPLIFIER** for operation with our DUAL CHANNEL PRE-AMPLIFIER; this provides for a more versatile installation and is essential if a low output Pick-up is to be used. When ordering specify loudspeaker impedance.

KIT OF PARTS **£27.0.0** BUILT AND TESTED **£34.0.0** (C. & I. 10/6.)

(3)

(2) MULLARD DUAL CHANNEL PRE-AMPLIFIER.

A four-valve design for both STEREOPHONIC and MONOPHONIC operation. Operates equally well with any make of Amplifier requiring input of up to 250 mV.

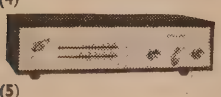
KIT OF PARTS **£12.10.0** BUILT AND TESTED **£15.0.0** (C. & I. 5/-.)

(4)

(3) THE "TWIN THREE" STEREO AMPLIFIER.

Based on a recent design by MULLARD LTD. it is ideally suited for use in PORTABLE RECORD PLAYERS for which purpose we offer a specially designed case: it incorporates MULLARD ECL86 valves, separate BASS and TREBLE CONTROLS, PARTRIDGE output transformer producing up to 3 watts per channel. Frequency response is 40 c/s to 35 Kc/s. Size 11½ × 3 × 5in. BUILT AND TESTED **£9.0.0** (C. & I. 7/6.)

To construct a STEREO PORTABLE RECORD PLAYER we offer:— Assembled AMPLIFIER with two ROLA 8 × 5in. LOUDSPEAKERS and PORTABLE CASE for **£16/10/-.** (C. & I. 10/-.)

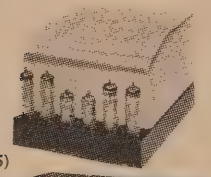


(5)

(4) THE "TUDOR" STEREO AMPLIFIER.

A self-contained shelf mounting Amplifier designed to provide high quality stereophonic and monophonic reproduction. Each channel provides a rated output of 6 watts and for monophonic operation approx. 12 watts is produced. Separate BASS and TREBLE CONTROLS. The Cabinet is finished in black crackle. Size 14 × 8 × 4in. Send for full specifications.

PRICE ONLY **£15.0.0** (C. & I. 7/6.)

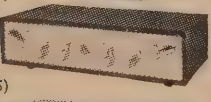


(5)

(5) TUDOR STEREO HI-FI SYSTEM.

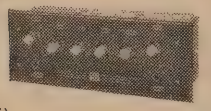
Comprising a self-powered AM/FM Tuner, Stereo Pre-amplifier and 12 watt per channel Stereo Power Amplifier. The Tuner and Pre-amplifier are housed in matching black crackle finish metal Cabinets for shelf mounting, with silver metal dials and matching knobs. SPECIFICATIONS: Tuner—outstanding quality providing full VHF/FM Long and Medium waveband coverage, frequency range FM 87.5-108.5 Mc/s. AM MW 522-1,630 Kc/s. LW 145-270 Kc/s. 100 mV output mains supply 105/240 v. A.C. Valve line-up: ECC85, ECH81, EBF89, EF80, EB91, EM84, ECC83. Multiplex outlet provided. **Pre-Amplifier**—Designed for use with the Tudor Stereo Power Amplifier with inputs for most types of Pick-ups, direct play from Tape Heads and ample sensitivity for either Crystal or Moving Coil Microphone. Distortion .1% tape output 100 mV from 90 K/ohm source, inputs—Microphone 5 mV, Tape 3.5 mV, R.I.A.A. 4.3 mV, flat 250 mV, Tuner 100 mV. Valve line-up: 2-EF86, 4-ECC83. **Power Amplifier**—14 watts per Channel, sensitivity 1 volt r.m.s. for 14 watts output, frequency response +0.5 dB 20 c.p.s. −20 Kc/s, Speaker impedance 4, 8, or 16 ohms. Surplus power available for tape pre-amplifier. Mains supply 105/240 v. A.C. Valve line-up—2-ECC83, 4-EL84, 1-GZ34

ALL FOR ONLY **48 Gns.** (C. & I. 15/-.)



(5)

★ MONO AMPLIFIERS ★



(6)

(6) MULLARD 3-VALVE PRE-AMPLIFIER TONE CONTROL UNIT.

Designed mainly for the STERN/MULLARD range of Monophonic Power Amplifiers, but also suitable for any Amplifier requiring an input signal up to 250 mV. Five inputs, including one equalised for replay direct from high impedance tape head, and one for low output magnetic pick-up. Output for tape record. Separate Bass and Treble controls. High Pass Filter 20 to 160 c/s. Low Pass Filter 5 to 9 kc/s. Power requirements—250 v. at 6 mA, 6.3 v. at 0.3 amps. Totally enclosed case silver hammered. Size 11¼ × 4½ × 4in. Front panel in polished Perspex with choice of black or white.

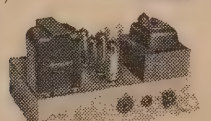
KITS OF PARTS **£10.0.0** BUILT AND TESTED **£13.13.0** (C. & I. 5/-.)

(7)

(7) MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT.

Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIERS but also perfectly suitable for other makes. Equalisation for the latest R.I.A.A. characteristics. Input for Crystal and low output magnetic pick-ups. Input (a) Direct from High Imp. Tape Head; (b) from a Tape Amplifier or Pre-Amplifier. Sensitive Microphone Channel. Wide range BASS and TREBLE Controls.

KIT OF PARTS **£6.6.0** BUILT AND TESTED **£9.10.0** (C. & I. 5/-.)



(8)

(8) MULLARD "5-10" MAIN AMPLIFIER.

For use with MULLARD 2- or 3-valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS AND MULLARD VALVES including PARTRIDGE MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer.

KIT OF PARTS **£10.0.0** BUILT AND TESTED **£13.10.0** (C. & I. 6/6.)

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER **£1/6/-** extra.

(9)

(9) MULLARD "5-10RC" AMPLIFIER.

The popular "5-10" complete incorporating Passive Control Unit providing up to 10 watts high quality reproduction with an input of 600 mV. Specified components include new MULLARD VALVES, PARTRIDGE MAINS TRASFORMERS and choice of the latest PARMEKO or PARTRIDGE Output Transformers. Surplus power available for tuner.

KIT OF PARTS **£12.0.0** BUILT AND TESTED **£16.0.0** (C. & I. 7/6.)

WITH PARTRIDGE OUTPUT TRANSFORMER **£1/6/-** extra.

(10)

(10) MULLARD "3-3RC."

A HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-WATT MULLARD "3-3" DESIGN. Complete to the MULLARD specification including PARMEKO OUTPUT TRANSFORMER. Switched inputs for 78 and L.P. records plus a Radio position. Power to drive a Radio Tuner is also available.

KIT OF PARTS **£8.8.0** BUILT AND TESTED **£11.10.0** (C. & I. 6/6.)

INSTRUCTION BOOKS AND DETAILED PRICE LISTS are Supplied Free with Kits of Parts but may be purchased separately if required.

Items 1, 2 and 14, **3/-** each; 6 and 13, **3/6** each; 7, 8, 9, 10 and 21, **2/-** each; 11, 15 and 20, **2/6** each; 12, **5/-**. All Post Free. (Instruction booklet for item 19 is same as item 14.)

IF YOU ARE PLANNING TO INSTALL HI-FI

and uncertain of the type of equipment to use—our widely experienced technical staff will with pleasure put forward recommendations. State type of installation contemplated and approx. price level. Credit Sale Terms are available on all equipment over **£10.** Send S.A.E. for fully descriptive leaflets on items of interest and copy of our interesting little booklet, "**What is High Fidelity?**"

COMBINED PRICE REDUCTIONS

(a) The KIT OF PARTS to build both the "**5-10**" **Main Amplifier** and the **2-valve Pre-Amplifier**..... **£15.15.0**

(b) KIT OF PARTS to build the "**5-10**" **Main Amplifier** and **3-Valve Pre-Amplifier** **£19.10.0**

(C. & I. 8/6 extra)

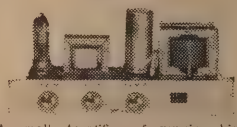
(a) The "**5-10**" and the **2-valve Pre-Amplifier** both Assembled and Tested **£21.10.0**

(b) The "**5-10**" and the **3-Valve Pre-Amplifier** both Assembled and Tested **£25.10.0**

(C. & I. 10/- extra)

With PARTRIDGE OUTPUT TRANSFORMER **£1/6/-** extra.

(11) THE "MONO-GRAM"



A small Amplifier of genuine high quality performance. Incorporates MULLARD ECL86 Valve, separate BASS and TREBLE controls, PARTRIDGE Output Transformer producing up to 3 watts undistorted output.

KIT OF PARTS **£4.10.0**

BUILT AND TESTED **£6.0.0**

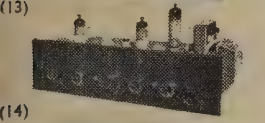
(C. & I. 3/6.)

THE "MONO-GRAM" is perfectly suited for Portable Installations for which purpose we offer—PORTABLE CASE **£3/10/-**; the AMPLIFIER (Kit) and 8 × 5in. SPEAKER (**£1**). All for **£9** or with **ASSEMBLED AMPLIFIER £10.** (C. & I. 5/-.)

The case quoted above will accommodate some 4-speed Single Record Units. A larger model for autochange is available for extra **10/-**. With this Equipment a COMPLETE PORTABLE RECORD PLAYER can be built for **£14.**

(12)

(13)



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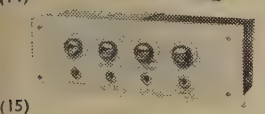

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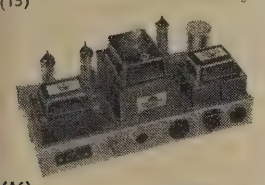

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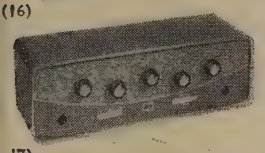

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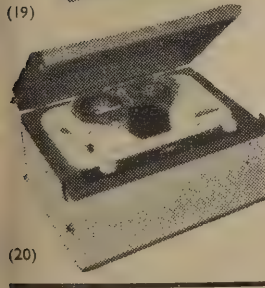


(20)

(12) STEREO TAPE PRE-AMPLIFIER Model STP-I.

For use with current TRUVOX, BRENELL or COLLARO "STUDIO" ¼- and ½-track Stereo Decks. Incorporates Ferroxcube Oscillator, 4-speed Equalisation, Signal Level Meter and separate Gain Controls. Includes separate Power Unit.

KIT OF PARTS **£22.0.0** BUILT AND TESTED **£28.0.0** (C. & I. 8/6.)

(13) MULLARD TYPE "C" TAPE PRE-AMPLIFIER.

Suitable for most ½-track Mono Tape Decks. Incorporates Ferroxcube Push Pull Oscillator and 3-speed equalisation. Includes separate Power Unit.

KIT OF PARTS **£14.0.0** BUILT AND TESTED **£19.10.0** (C. & I. 7/6.)

(14) MULLARD TAPE AMPLIFIER Model HF/TR3.

Based on Mullard's type "A" design and suitable for most ¼-track Mono Tape Decks. Incorporates Ferroxcube Treble Inductor, Gilson Output Transformer, and 3-speed equalisation. Includes separate Power Unit using PARTRIDGE Mains Transformers.

KIT OF PARTS **£13.13.0** BUILT AND TESTED **£19.0.0** (C. & I. 7/6.)

(15) MULLARD FOUR-CHANNEL MIXING UNIT.

Self-powered Cathode Follower output. Incorporates two inputs for CRYSTAL MICROPHONES, one for CRYSTAL PICK-UPS and a fourth for Radio or Tape.

KIT OF PARTS **£8.8.0** BUILT AND TESTED **£11.10.0** (C. & I. 7/6.)

Alternative Model I/L provides for one input matched for moving coil or ribbon mike **£1/17/-** extra.

THE NEW STERN DOUBLE FEATURE PRE-AMPLIFIER AND JL10 POWER AMPLIFIER

A new conception in the field of audio engineering by Stern-Clyne development engineers. The most up-to-date circuitry is used in the double feature pre-amplifier. It has matched inputs for microphone, crystal or magnetic pick-ups and radio tuner and in addition offers full facilities for tape recording and high fidelity replay. This unique feature means that should you wish to include tape in your hi-fi system at a later date all that is required is a suitable tape deck.

(16) JL10 POWER AMPLIFIER

incorporates the latest triode/pentode ECL86 valves in push-pull, PARTRIDGE ultra linear output transformer, PARTRIDGE mains transformer and smoothing choke. 10 watts power output, surplus power available for tuner. Output impedance 3-7.5-15 ohms.

KIT OF PARTS **£11.11.0** BUILT AND TESTED **£14.14.0** (C. & I. 7/6.)

(17) DOUBLE FEATURE PRE-AMPLIFIER.

Inputs for microphone, crystal or magnetic pick-ups, tuner unit, push-button switching for 3 tape speeds equalised. Tape erase Bias Oscillator circuit incorporating ferroxcube transformer. Function switch, separate bass, treble and volume controls, level control and latest EM87 magic-eye level indicator. The pre-amplifier is totally enclosed in a silver hammered finish steel case. An attractive Perspex front panel carefully designed to blend in with modern wood finishes complete the presentation.

KIT OF PARTS **£17.0.0** BUILT AND TESTED **£21.0.0** (C. & I. 5/-.)

Prices if both units purchased together:—

KIT OF PARTS **£27.10.0** BUILT AND TESTED **£33.12.0** (C. & I. 10/-.)

(18) STEREO TAPE DECK WITH BUILT-IN PRE-AMPLIFIER.

A professional addition to your Hi-Fi Stereo System consisting of two basic Units, the Tape Deck and Pre-amplifier, which employs 4 Transistors and 4 Valves. The unit will record and playback ¼-track stereo or ½-track mono at either 7½ i.p.s. or 3¾ i.p.s., both speeds being fully equalised. Features: **Track System:** ¼-track 2 channel stereo or monaural record and playback. Independent single channel recording on either channel while playback on other channel. Head Type: ½-track 2 channel in-line stereo and associated erase heads. Low loss laminated pole pieces. **Level Indicators:** 2 Meters, 1 per channel. **Digital Counter:** 3 digit tape position indicator. **Automatic Stop:** When tape runs out or breaks. **Inputs:** Microphone 1 mV (50 K/ohms impedance). Gram/Tuner 50 mV (high impedance). **Output:** (cathode follower). **Monitor Sockets:** 2 × 5 K/ohms impedance. **Audio Output:** 500 mV. **Oscillator:** Push-pull 80 kc/s. **S/N Ratio:**—45 dB or better at 7½in. tape speed. **Separation:** 45 dB or more between stereo channels. **Frequency Response:** 40 to 15,000 cycles per sec. at 7½ i.p.s., 40 to 9,000 cycles at 3¾ i.p.s. **Single Motor:** 4-pole heavy duty induction type. **Power Supply:** 240 v. A.C. 50 cycles. **Size:** 6½ × 10½ × 15in. **Tape Size:** Up to 7in. **Line-Up:** 4-2SB173 transistors, 2-12AT7, 1-12AU7, 1-12BH7 Valves.

PRICE **42 Gns.** (C. & I. 15/-.)

(19) MODEL CR3/S TAPE RECORDER.

Incorporates the HF/TR3 Mk. II Tape Amplifier (described above) and the Collaro "Studio" Twin Track 3-speed Deck operating at 1⅞in. 3¾in. and 7½in. Complete with Microphone and 1,200ft. Tape.

KIT OF PARTS **£33.8.0** BUILT AND TESTED **£43.0.0** (C. & I. 15/-.)

(20) MODEL HF/G2R PORTABLE TAPE RECORDER.

Incorporates the latest Garrard "Magazine" Tape Deck and Matching Amplifier based on the successful MULLARD TYPE "A" DESIGN and specifically developed to operate the GARRARD DECK. PRICE INCLUDES THE GARRARD TAPE MAGAZINE and 4in. SPOOL OF DOUBLE-PLAY TAPE. A Twin Track Recorder operating at 3¾in./sec. providing up to 1 hour 10 mins. playing time. The outstanding features being excellent performance and simplicity of operation. Incorporates EXT. SPEAKER SOCKET, also operates as independent amplifier for direct reproduction from P.U. Mike or Radio Tuner. Weighs only 22 lb.

(ORIGINAL PRICE £33.) NOW ONLY **22 Gns.** (C. & I. 10/-.)

Microphone 25/- extra.

Model HF/G2R IS ALSO AVAILABLE LESS CABINET AT 19 GNS. (C. & I. 10/-.)
A complete Tape Recorder Chassis ready for easy fitting into cabinet. Microphone 25/- extra.

HI-FI PORTABLE TAPE PRE-AMPLIFIERS

ready to use incorporating our Type "C" TAPE PRE-AMPLIFIER and choice of Tape Deck in attractive portable carrying case.

(T.11) **COLLARO STUDIO** 3-speed deck **£40**

(T.1) **BRENELL** Mk. 5 Series, Series II, 3-speed deck **£63**

(T.12) **WEARITE** Model 5A deck **£75**

(C. & I. 15/- extra.)

COMBINATION TAPE UNITS

All our Tape Units can be supplied specially matched to any Tape Deck such as Collaro, Brenell Mk. 5 Series II, also the Wearite. Specimen prices as below.

STP-1 Pre-amp. with Collaro Studio Tape Deck.
KIT £36. ASSEMBLED £42.
Assembled with track switch fitted, **£44/2/-.**

STP-1 with Brenell Mk. 5 Series II with Track Switch fitted.
KIT **£68/4/-**

STP-1 with Brenell Mk. 5 Series II ¼-track Deck.
KIT **£74/15/-**

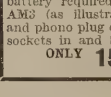
Type "C" Pre-amp. with Collaro Studio Tape Deck.
KIT £24/10/-. ASSEMBLED £30.
Assembled with deck wired and matched ..... **£32/2/-.**

Type "C" Pre-amp. with Brenell Mk. 5 Series II Deck.
KIT £46/11/-. ASSEMBLED £53/1/-.
Assembled with deck wired and matched **£55/3/-**

HF/TR3 with Collaro Studio Tape Deck.
KIT £24/3/-. ASSEMBLED £29/10/-.
Assembled with deck wired and matched **£31/12/-**

HF/TR3 with Brenell Mk. 5 Series II Deck.
KIT £46/4/-. ASSEMBLED £51/11/-.
Assembled with deck wired and matched **£53/13/-**
Carr. & Ins. 15/- on above units.
Send S.A.E. for comprehensive price list.

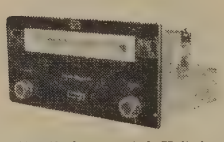
PLUG-IN AUDIO MIXER



An extremely versatile two-channel mixer with individual volume controls. Plugs into single high impedance input. Suitable for Tape Recorders, Amplifiers, etc. NO battery required. Two types available: AM3 (as illustrated), phono sockets in and phono plug out. AM5 Standard Jack sockets in and Standard Jack plug out.

ONLY **15/-** P. & P. 1/6.

(21) Mk. II "FIDELITY" F.M. TUNER UNIT



An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line-up. Very suitable to operate with our Mullard amplifiers.

KIT OF PARTS **£10.0.0**
BUILT AND TESTED **£14.5.0**
(C. & I. 5/-.)

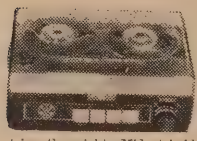
TURN OVER FOR MORE STERN-CLYNE PRODUCTS AND ADDRESSES →

Great Britain's Greatest Electronic Hobbies Organisation

4WW—108 FOR FURTHER DETAILS.

STERN-CLYNE

POCKETCORDER TRANSISTORISED RECORDER



Why be bothered with a notepad? Take a Pocket Corder with you on those business trips, the mighty Midget is ideal. Simple to operate, a unique 4-way push-button Switch for record/playback, etc., and remote control switch built into microphone ensures complete ease of operation. Fully adjustable speed through the life of Batteries and the volume and Tone from the 2½in. internal speaker is outstanding. All accessories included such as Leather Case, Accessory Case and Crystal Earpiece, Tape, Batteries and Microphone, no other extras required. Up to 34 mins. recording time, operates on 1-9 volt PP3 and 2-1½volt U12 Pen Batteries. Size 5½×4×2in. Weight 24 ozs. SPARE 2½in. empty spools 1/- each: 2½in. 200ft. L.P. Tape 5/-.

PRICE **12 Gns.** P. & P. 4/-.

THE NEW CHASSIS PUNCH SET

Five of the most used Hole Punches made of the finest hardened steel, will save hours of tedious hand labour, suitable for Aluminium, Sheet Metal, Plastic, etc. Punch sizes ⅛in., 11/32 in., ¼in., 1in., 1 3/32 in., complete with Tommy Bar, Tapered Reamer and Zip Fastening Carrying Case.

PRICE **49/6** P. & P. 3/6.

RECORD PLAYERS

GARRARD Model SRP10 Single Record Player fitted with high output crystal pick-up, **£5/9/1.**

THE NEW GARRARD "AUTOSLIM" 4-speed Autochanger with crystal pick-up, **£6/10/-.**

GARRARD "AUTOSLIM DE LUXE" 4-speed Autochanger, incorporates transcription Pick-up Arm, **£11/8/-.**

THE COLLARO "C60" 4-speed Autochanger unit with Crystal cartridge, **£6/19/6.**

B.S.R. Model UA14, a 4-speed Mixer Autochanger with crystal pick-up, **£5/19/6.**

The new **GARRARD Model 4HF** High Quality Single Record Player fitted with the latest T.P.A. 12 pick-up arm and G.C.S. crystal Cartridge, **£16/17/6.**

PHILIPS Model AG1016. A 4-speed Player which can be operated both manually and automatically. Suitable for Mono or Stereo operation, **£12/12/-.**

Carriage and insurance on each above 5/- extra.

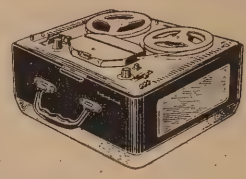
WE CAN SUPPLY ALL COMPONENTS TO CONSTRUCT THE

NEWMARKET TRANSISTORISED TRANSFORMERLESS PUSH-PULL 3-WATT AMPLIFIER

as described in December issue. Send S.A.E. for component price list.

AMAZING PURCHASE !

FULL FEATURE HIGH QUALIY MAINS PORTABLE TAPE RECORDER Model MTR2



ONLY 22 Gns. COMPLETE (C. & I. 15/-)

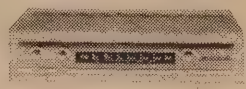
or H.P. Terms **£4/14/-** DEPOSIT (Plus C. & I.) and 12 monthly payments of **£1/13/9.**

NOW YOU CAN AFFORD A PROFESSIONAL TAPE RECORDER. JUST LOOK AT THESE STAR FEATURES:—

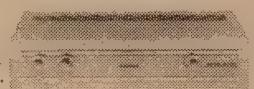
★ Two speeds, 1⅞in. and 3¾in. (fully equalised). ★ Output 4 watts. ★ Twin Track. ★ 7in. ×4in. Elliptical Speaker. ★ Push button controls. ★ Separate tone and volume controls. ★ Takes up to 5in. spools. ★ Frequency response: 1⅞in.—70 to 6,000 c/s; 3¾in.—50 to 12,000 c/s ★ Inputs for Radio, Mike and Pickup. ★ Output sockets for Headphones and Extension Speaker. ★ Instant reset tape positioning indicator. ★ Magic eye record level indicator. ★ Attractive two-tone sturdy case with carrying handle and zipped cover. ★ A.C. Mains 110/240 v. Absolutely complete with all accessories including Moving Coil Microphone with table stand, full 5in. reel of tape and spare spool, recording lead, spare drive belt, etc.

THE "MIDLAND" TWIN SET

Consisting of F.M. TUNER and matching AMPLIFIER beautifully finished in two-tone beige with chrome knobs, trimmings and feet. Designed to comply with the modern day requirements for shelf mounting equipment.



PRICE 26½ Gns PLUS C. & I. 10/-.



Specifications:

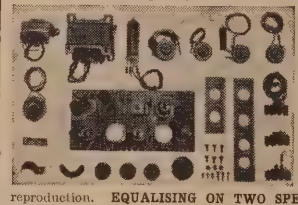
F.M. TUNER. Frequency coverage 88-108 mc/s. Output 0.7v. Sensitivity 42 db/0.1v. Self powered. Mains supply 200/240v. A.C. Automatic frequency control. Incorporates 1-RF stage, 1-IF stage, 1-Limiter stage and 4 modern miniature valves and 2 diodes.

AMPLIFIER: 4 watts undistorted output Separate Bass and Treble controls. Volume/On/Off control. Inputs for tuner and crystal pickup. Output impedance 4, 8 and 16 ohms. Incorporates 4 modern miniature valves. Dimensions of each unit 3¾in. × 12¾in. × 7¾in.

(Regret these items cannot be supplied separately)

BUILD YOURSELF AN INEXPENSIVE TAPE RECORDER !

LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. Incorporating Record Interlock Lever, 3 motors, 1⅞, 3¾, 7½ i.p.s., takes 7in. spools. Push button controls. **NEW LOW PRICE OF £10/10/- ONLY** plus 7/6 P. & P. Usual H.P. facilities.



NEW TAPE RECORDER AMPLIFIER TYPE 8311-V. Sub-assembled—anyone can build. Printed Circuit, all components mounted and dip soldered. Already tested. Each lead cut to length. All that is required to complete the tape recorder is for a few components to be mounted in the cabinet and the free end of the leads soldered to terminals which are clearly marked, everything supplied, all you need is solder iron, pliers and screwdriver. Valve line-up: EF86, ECC83, 2 × EL84, EZ81 and EM34 magic eye. Monitoring facilities, output socket for feeding to high quality amplifier can be used as "straight" amplifier for record reproduction. **EQUALISING ON TWO SPEEDS. OUTSTANDING VALUE AT £11/11/-** plus 2/6 P. & P. including all necessary instructions.

ATTRACTIVE TWO-TONE PORTABLE CARRYING CASE. Suitable for above amplifier and Collaro Studio deck. Fitted 9in. × 5in. High Flux P.M. speaker for high quality reproduction. Inclusive price **£5/5/-** plus 5/- P. & P. Full list of competitively priced mics. and stands on request. The above 3 items purchase at one time **SUPPLIED CARRIAGE PAID.**

NOW AVAILABLE. FOUR-TRACK STUDIO DECK AS ABOVE FITTED WITH HI-FI FOUR TRACK HEADS. PRICE £13/19/6, plus 7/6 P. & P. Four track heads supplied separately, complete with mounting bracket for Studio Deck at 92/6 pair, plus 2/6 P. & P.

TAPE RECORDER AMPLIFIER 8311-4V exactly as 8311-V but four-track, suitable for hi-fi four track heads. **Price £12/12/-.** P. & P. 2/6.

N.B. Four-track deck and amplifier fit the above case without any modification whatsoever.

PRE-AMPLIFIER KIT TYPE 8312-CP. Complete high quality pre-amplifier kit for use with Collaro Studio Deck. **Price £8/8/-,** plus 2/6 P. & P.

HI-FI STEREO HEADPHONES

For the connoisseur who requires perfection. Each Earphone consists of a 2in. Dynamic Loudspeaker with a full frequency range, fitted with foam rubber Ear Pads for added comfort, to keep out noise and to maintain an excellent bass response. The resistance Junction box with change-over switch provides simple transfer from Phones to Speaker. Specifications: **Frequency Range** 25-15,000 c.p.s. **Input Impedance**—16 ohms. **Power Rating**—¼ watt. **Weight**—13 ozs. **PRICE 5 Gns. P. & P. 2/6.** Junction box 15/- extra.

STEREO STETHOSCOPE HEADSETS

Enjoy personal listening in absolute comfort with the new lightweight Stethoscope Headsets suitable for stereo or monaural. Magnetic low impedance. Complete with 6ft. of Cable and Stereo Jack Plug.

PRICE **25/-** P. & P 1/6

ACOS MONAURAL STETHOSCOPE HEADSETS

Suitable for Tape Recorders, or monitoring tape recorders, 100 ohm. impedance magnetic. Complete with lead.

(Originally 21/-.) OUR PRICE **12/6** P. & P. 1/6

MONAURAL STETHOSCOPE HEADSETS

Suitable for Radio Tape Recorders, or monitoring tape recordings, magnetic low impedance or Crystal High impedance. Complete with 4ft. of lead and miniature Jack Plug.

PRICE **10/6** P. & P. 1/6

THE MINICO JUNIOR TRANSISTORISED TAPE RECORDER

Record anywhere anytime. A truly portable versatile Recorder with a difference, the highly sensitive Crystal Microphone is built into the Zip Carrying Strap which leaves both hands free to operate your Cine Camera, the Microphone can be removed for office use as a Dictating Machine or for Parties. Outstanding quality of reproduction and tone, up to 45 mins. playing time, twin track and operating on 4-1½ volt Half-Pen Batteries. Robust Metal body, size 6½×4½×2½in. weight 33 oz. Usual price 16 gns.

OUR PRICE **£6.19.6** P. & P. 4/-.

Complete with Microphone, Tape and Battery.

THE SINCLAIR SLIMLINE

A new 2-TRANSISTOR printed circuit pocket radio. Completely portable—the smallest ever—only 2¾in.×1⅝in.×¾in. Uses Micro-Alloy Transistors and with built-in ferrite aerial will receive all stations on M.W.—B.B.C.—208, etc. Easy to assemble—no alignment problems. All required components, including earpiece. ONLY **49/6** P. & P. 1/6

All parts sold separately.

RECORDING TAPE BARGAINS !

"BEL-CLEER"

FOR THE FIRST TIME IN THIS COUNTRY CANADA'S HI-FI MAGNETIC RECORDING TAPE—MADE BY "BEL CLEER" OF CANADA.

Following sizes available—others to follow. BRAND NEW—NOT SUB-STANDARD.

High grade acetate base. Attractively boxed fitted leaders, fully guaranteed.

5in. 600ft. **12/6;** 5in. 900ft. **15/-.** 5½in. 1,200ft. **18/6.** 7in. 1,200ft. **18/6.** 7in. 1,800ft. **25/-.**

"LAFAYETTE"

AMERICAN RECORDING TAPE. MYLAR BASE. Brand new and boxed. Fully guaranteed.

3¾in. 600ft. **11/6;** 5in. 1,200ft. **15/-.** 7in. 1,200ft. **15/-;** 7in. 1,800ft. **20/-.** 7in. 2,400ft. **27/6.**

MESSAGE TAPES.

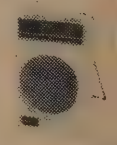
British manufacture. Polythene. 3in. 150ft. **3/8;** 3in. 240ft. **5/6;** 5in. 300ft. **8/-.** P. & P. 6d. per spool, 3 or more post free.

2½in. 200ft. L.P. TAPE, **5/-.**

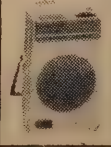
PLASTIC SPOOL CONTAINERS for spool sizes: 5in. **1/6;** 5½in. **2/-;** 7in. **2/3.**

PLASTIC TAPE SPOOLS. Best quality. 2½in. **1/-;** 3in. **1/3;** 4in. **2/-;** 5in. **2/-;** 5½in. **2/3;** 7in. **2/6.** Any single item plus 6d. P. & P. Orders over £1 post free.

THE DUVIDAL TWO-WAY TWO TRANSISTOR BATTERY INTERCOM

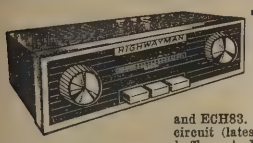


A completely Portable Intercom ideally suitable for the office or as a Baby Alarm—being battery operated it is completely safe. Two-way calling system and volume on/off switch, housed in attractive plastic cabinets with chrome stands. Replacement PP3 Battery costs only **2/6.** Complete with battery and 25 yds. lead and pluge. **69/6**



P. & P. 3/6.

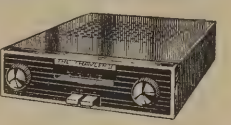
NEW LOW PRICES—NOW YOU CAN AFFORD A CAR RADIO!



The "HIGHWAYMAN"

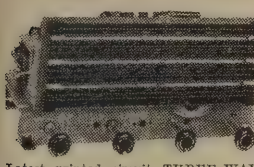
OUR QUALITY CAR RADIO TO BUILD YOURSELF AT A NEW LOW PRICE. Look at these features:—★Attractive styling. ★ Push-pull output. ★ Three latest Mullard transistors plus valve types EBF83 and ECH83. ★ No buzz, high output and sensitivity. ★ Printed circuit (latest type). ★ 7×4in. high flux p.m. speaker and baffle. ★ Medium and Long Waves. ★ Push button for fingertip control. ★ Extremely low battery consumption (less than ½ amp.). ★ Easy to fit any make car (positive earth only). ★ 12-volt operation. ★ Compact size, measures only 7×7×2in. deep. ★ Easy assembly, supplied with dial and drive already mounted. Special inclusive price of **Only £7.19.6** Plus 5/- P. & P. All parts available separately. Individually priced parts list and comprehensive instruction booklet **2/6** post free. (Deducted from cost if complete parcel purchased later.)

THE "TRAVLER" MK.II



Introducing our new ready built transistorised car radio for only **9½ Gns.** P. & P. 5/-. including 7 × 4in. speaker fitted to baffle, fixing brackets, filter unit, all nuts and bolts with fitting instructions.
H.P. Terms: £2/19/6 deposit (plus P. & P.) and 7 monthly payments of 22/6.
STAR FEATURES:
★ Handsomely Styled. ★ Mullard Valves and Transistors. ★ Push Buttons. ★ 1½ watts Output. ★ Long and Medium Wavebands. ★ Quality Speaker (E.M.I.). ★ Easily Fitted. ★ Radio Luxembourg (and many other foreign stations). 12-volt Positive Earth Only (applies to 99.8% of cars on the road). ★ Dimensions 7×2×7in. depth.
Optional extras: 3-section chromium plated weatherproof telescopic aerials type 1 17"/44" **19/6.** Type 2, 2"/43" **29/6,** both plus p. & p. 2/6 if purchased separately.

SPECIAL CHASSIS BARGAIN!



Latest printed circuit, THREE WAVE, Long, Medium and Short. Extremely sensitive, ferrite rod aerial. 4 watts output. Valve line-up: ECL82, EZ80, EBF89, and ECH81. Tape and gram inputs. Tone control. Attractive dial (size 12½ × 4¼in.) in maroon with gold lettering. Overall chassis size 12⅝ × 4⅝ × 7¼in. high. A.C. 200/250 v Fully guaranteed **SPECIAL PRICE £9.19.6**
Plus 5/- P. & P. **H.P. available.**

THE "AIR KING"

Our highly successful six-transistor luxury portable with the "SLIM Line" look. To build yourself, with printed circuit chassis for reliability and simplicity in construction. May be used as car radio, with full M.W. and L.W. coverage. LOOK AT THESE FEATURES:
★ 500 milliwatt output to high flux 7×3⅜in. high fidelity loudspeaker. ★ Six selected MULLARD TRANSISTORS in latest supersentive circuit plus germanium diode. ★ Compact size only 9½ × 3⅝ × 6¾in. high. ★Attractive three-tone cabinet, black, dark grey, and silver grey with gilt control knobs and all gilt fittings. ★ Co-ax. socket for car aerial. ★ Brand new guaranteed components. ★ Push-pull output. ★ Automatic volume control. ★ Long-life battery. ★ Super-sensitive internal ferrite rod aerial. Special inclusive price for all required components. ONLY **£7.19.6**
Plus P. & P. 4/-.
Alignment service available. Full assembly details and individually priced parts list, all of which are available separately. Price 1/6, post free.

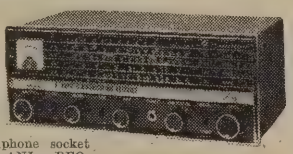
ANOTHER NEW BRANCH!

OPENING SHORTLY AT

20-22, WITHY GROVE, MANCHESTER 4.

The finest selection of Hi-Fi Equipment and a fully comprehensive range of components etc., for the Do-it-Yourself enthusiast.

THE HE-40 4-BAND COMMUNICATION RECEIVER



Completely built and ready to go. High sensitivity Superhet receiver covering 550 kc/s-1,600 kc/s, 1.6 Mc/s-4.4 Mc/s., 4.4 Mc/s-11 Mc/s, 11 Mc/s-30 Mc/s. Electrical band-spread tuning. Slide-rule type tuning dial. Internal ferrite rod aerial for Medium wave-band reception and a 59in. 10-section chromium plated telescopic whip aerial for the Short wave bands. Sockets for optional outdoor aerial. Internal monitor loudspeaker. Latest modern miniature B7G bass valves. Headphone socket (may also be used for external loudspeaker). ANL. BFO. Receive/Stand-by switch. Built-in "S" meter 220/240 volt A.C. mains, 50-60 cycle operation. Handsomely styled cabinet with grey crackle finish and handsome front panel, with chrome and satin chrome fittings. Size 13⅜ × 8½ × 5¾in. Wgt. 11¼ lbs. A comprehensive instruction manual is supplied. An ideal receiver for the radio amateur and Short wave listeners of all ages. Send S.A.E. for leaflet. Carr. & Pkg. 12/6. **£24.15.0**

THE HE-30 4-BAND COMMUNICATION RECEIVER

One of the finest general coverage bandspread Receivers available at this price. Covering 550 kc/s-1,600 kc/s, 4.8 Mc/s-14.5 Mc/s, 1.6 Mc/s-4.8 Mc/s, 10.5 Mc/s-30 Mc/s. Illuminated slide rule dial calibrated every 5 kc/s on 80 and 40 metres. Edgewise S-meter, 0-100 logging scale coverage from 0.55-30 Mc/s. 8 valve plus Rectifier Superhet circuit, RF stage with an Aerial Trimmer. 2 IF stages. BFO control. Q-multiplier. Controls: Function Switch, Audio Gain, Selectivity (Q-multiplier), Frequency (BFO), Band Selector, IF gain, Trimmer, AVC-MCV Switch, ANL Switch, Main Tuning, Band-spread Tuning and Headphone Jack, Selectivity—60 dB at 10 kc/s, 0.8 kc/s at 6 dB (with Q-Multiplier), IF—455 kc/s, External P.M. Speaker reqd. 4 or 8 ohms impedance. Output 1.5 watts. 8 modern Miniature B7G Bass Valves and 5Y3 Rectifier. Size 15 × 10 × 7¾in. Grey crackle finish. For operation on A.C. mains 220/240 v. 50/60 cycles.
Full instructions and circuit diagram supplied. **PRICE 40 Gns.**
Send S.A.E. for leaflet. Carr. & Pkg. 15/-.

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162, Holloway Road, N.7. NORth 8161/5. Half-day Thursday.
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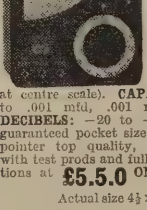
MODEL TK20A

Size 3¾ × 2½ × 1¾in. Meter size 2½ × 1⅜in. Sensitivity 1,000 o.p.v. on both A.C. and D.C.! A.C. and D.C. volts 0/15, 0/150, 0/1,000 volts D.C. current 0/150 mA. Resistance 0/100K. Complete with test prods, battery and full instructions. **OUTSTANDING VALUE AT ONLY 39/6**
Plus 1/6 P.& P.

MODEL TK50

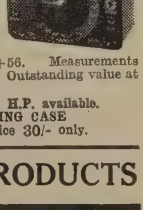
Size 5 × 3½ × 1¾in. 1,000 ohms per volt. D.C. current: 1-250 mA D.C. and A.C. volts 10,250, 500 and 1,000 v. Resistance: 0-10K, 0-100K. Complete with test prods, battery and full instructions. Outstanding buy at **57/6**
Plus 2/6 P. & P.

MODEL 200H 20,000 OPV



RANGES: A.C. VOLTS: 10, 50, 100, 500 and 1,000 volts (10,000 o.p.v.). D.C. VOLTS: 5-25, 50, 250, 500 and 2.5K (20,000 o.p.v.). **D.C. CURRENT:** 0-50 mA, 0.25 mA, 0-250 mA. **RESISTANCE:** 0-6k, 0-6 meg. (300 ohms and 30 k at centre scale). **CAPACITANCE:** 10 pf to .001 mfd, .001 mfd to .1 mfd. **DECIBELS:** −20 to +22 dB. A fully guaranteed pocket size meter, knife edge pointer top quality, supplied complete with test prods and full operating instructions at **£5.5.0 ONLY** Post free.
Actual size 4½ × 3⅜ × 1in.

MODEL 500



30,000 OHMS PER VOLT. 9-range D.C. voltage to 1 kV, 7 ranges A.C. voltage to 1 kV. 5 ranges D.C. current to 12 amp., 3 ranges resistance to 60 meg. Incorporating internal buzzer for audible warning of direct shorts and blocking condensers for A.F. output. Capacity −20, +56. Measurements 3⅛ × 6⅝ × 2¼in. Outstanding value at **£8.19.6** **H.P. available.**
LEATHER CARRYING CASE for Model 500. **Price 30/- only.**

ALSO SEE PAGES 80, 81 and 82 FOR MORE STERN-CLYNE PRODUCTS

Great Britain's Greatest Electronic Hobbies Organisation

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TEST METERS

30,000 OHMS PER VOLT MODEL 500. Reads voltages up to 1,000 D.C. at 30,000 ohms per volt and A.C. at 15,000 o.p.v.; D.C. current to 12 amps.; Resistance to 60 Megs.; Decibels from −20 to +56; Incorporates internal buzzer for audible warning of direct shorts and blocking condenser for AF output measurements. Size 3 5/16 × 6 5/16 × 2 3/4in. **£8/19/6.**

2,000 OHMS PER VOLT MODEL TP-10. Reads A.C. and D.C. volts up to 1,000; D.C. current to 500mA; Resistance to 1 Meg.; Capacitance to 1μF; Decibels from −20 to +36; Output jack for Audio measurements. Size: 3 1/2 × 5 × 1 1/2in. **£3/19/6.**

LAVOIE UHF WAVEMETER MODEL 105. Coverage 375/725 Mc/s. Complete with correct Calibration Chart. First-class condition. Battery operated and portable. Size 11 × 8 × 7 3/4in. ONLY **£3/19/6** (carriage 7/6).

20,000 OHMS PER VOLT MODEL TP-5S. Reads voltages up to 1,000 D.C. at 20,000 ohms per volt and A.C. at 10,000 o.p.v.; D.C. current to 500mA; Resistance to 10 Megs; Capacitance to 0.1μF; Decibels from −20 to +36. Size: 3 1/2 × 5 1/2 × 1 1/2in. **£5/19/6.**

PANEL METERS

25 microamps D.C. 2 1/2in. Proj. circular **59/6.** 50 microamps D.C. 2 1/2in. Flush circular, **59/6.** 100 microamps. D.C. 2 1/2in. Flush circular **39/6.** 200 milliamps. D.C. 2 1/2in. Flush circular, **12/6.** 40 amps. D.C. 2in. Proj. circular, **7/6.** 300 volts A.C. 2 1/2in. Flush circular **25/-.** 500 volts A.C. 2 1/2in. Flush circular, **25/-.**

HIGH FREQUENCY A.C. VOLTMETER

A First Grade Moving Iron Instrument with 6in. Mirror Scale, reading up to 150 volts A.C. at 400 and 1,200-2,400 cycles. In substantial Oak case with removable lid, overall size 8 1/2 × 8 1/2 × 5 1/2in. Made for the Air Ministry by Everett Edgcumbe, and in perfect order. Brand New and Unused. ONLY **£5.0.0.**

Can also be supplied for 50 cycles, use either 0-150 or 0-300 volts.

DOUBLE BEAM OSCILLOSCOPE TUBES

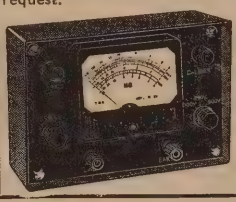
Another purchase of Type CV 1596, equivalent to Cossor 09D as used in Oscilloscopes by Cossor (339 series) and Hartley & Erskine (13 series). Listed £12. Brand new in maker's crates **25/-** (carriage 5/-)

MINIATURE MOTORS.

Ideal for models. Operate on 5-6 v. D.C. Size 1 1/2 × 1 5/16in., plus 1/2in. spindle. Brand new **5/-.**

TRANSISTORISED INSULATION TESTER

One handed operation, no cranking of generator. 3 testing voltages 100, 250 and 500, to measure up to 500 Megohms. Complete with leather carrying case and test leads. ONLY **£17/10/0.** Illustrated details on request.



AMERICAN DESK TELEPHONE

complete with handset. Non-dial type, but has internal bell. Ideal for extension or inter-com. BRAND NEW; ONLY **30/-.** (Post 4/-.

ACOS 39/1 STICK MIKE

with screened lead and table stand. ONLY **32/6.** (Post 1/6).

CRYSTAL DESK MIKE

with screened lead and built-in stand. ONLY **15/-.** (Post 1/6).

PCR COMMUNICATION RECEIVERS

Manufactured by **Pye and Philips.** One of the Army's most versatile and sensitive sets. RF stage and 2 of IF, using 6 British I.O. type valves. Large 180 degrees illuminated and calibrated dial. Flywheel tuning with locking device. Aerial trimmer. Tone and volume controls. Band switch. Front panel jacks for speaker or phones. In black metal case, size 17" L × 8" H × 10" D. **Model PCR2** covers 6-22 Mc/s, 200-550 metres, and 850-2,000 metres, **£5.19.6. Model PCR3.** As PCR2 but has 2 Short Wave Bands. 2.0-7.0 Mc/s and 7.0-23.0 Mc/s, and Medium Wave Band 190-550 metres. ONLY **£8.8.0.** Both types used but excellent condition. Every receiver aerial tested before despatch. Add 10/6 carr. both models. Designed to operate from bulky EXTERNAL power supply, but any set can be fitted with BRAND NEW COMPONENTS INTERNAL PACK for 200/250 v. A.C. at extra cost of **£2.** *S.A.E. for illustrated leaflet.*

HETERODYNE FREQUENCY METERS TYPE LM14

Frequency range 125-20,000 kc/s in 2 bands. This is the United States Navy Model of the well-known BC.221 Frequency Meter, but has many additional features which increase its usefulness. Voltage stabilisation circuits and Crystal control ensure extreme accuracy and in addition it is fitted with an Internal Modulation switch to allow use as a Signal Generator. Size only 8 1/2in. × 8in. × 8 1/2in. Full information on request.

COSSOR TYPE 1035 DOUBLE BEAM OSCILLOSCOPES. A few only of these modern scopes, overhauled and in perfect order ONLY **£45.** Further details on request.

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AERIAL MASTS

20FT. TELESCOPIC MAST. NEW all steel tubular 4 section Masts suitable for Roof or Wall fixing, as well as Base location, can be extended to full height or locked at any position by special Roller Cam locking rings. Drilled plate at the top allows for guying if necessary. Bottom section approximately 1 1/2in. diameter. Copperised and Sprayed finish. Weight 16lb.

Price £5.0.0 Carr. 7/6.

40FT. TELESCOPIC MAST. New Tubular Steel Mast, with guying points at top of each section. Each 8ft. section is locked in extended position by a Steel Pin. Bottom section 2 1/2in. dia. Ideal for Roof or Wall fixing, or sunk into Cement Base. Sprayed anti-corrosive finish. Wt. 38lb.

Price £10.0.0 Carr. 12/6.

LIMITED QUANTITY 36Ft. BRASS TELESCOPIC MAST

COMPLETE WITH BUILT-IN HAND WINDING WINCH FOR EASY RAPID EXTENSION. Finest quality. Non-rusting. Bottom section 2 1/4" dia. Winds down to 9ft. One of the best masts ever produced.

Price £35.0.0 Carr. 30/-

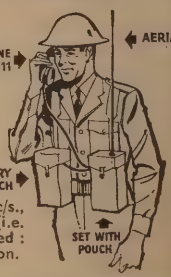
SUPPLIED COMPLETE WITH VALVES & CRYSTALS
Details & Prices of all Accessories supplied on request.

LATEST miniature WALKIE TALKIE

"88" set—Produced to exacting specifications by leading manufacturers E. K. Cole & Co.

Only **£10.0.0** EACH

This Transmitter/Receiver weighs only 5 1/2lb. (approx.) and measures 3 1/2in. x 5 1/2in. x 9 1/2in.



It is a 4 frequency channel set, **crystal controlled** 38-40/40-42 Mc/s., and operates from a Standard Dry Battery—H.T./L.T. 90 v./1.3 v. (i.e. Vidor L5537). 14 of the 'current series of B7G valves are employed : 1-3A4, 6-1L4, 4-1T4, 1-1S5, 2-1A3. Each set in first class condition. Special quotations for quantities.

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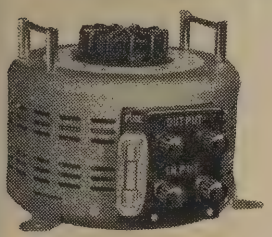
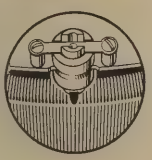
NEW TEST EQUIPMENT

WORLD FAMOUS "SLIDUP" VARIABLE TRANSFORMERS



Output: 0–260 v.
Input: 230 V.A.C. 50/60~.
A SHROUDED FULLY VARIABLE TRANSFORMER FOR BENCH OR PANEL MOUNTING.

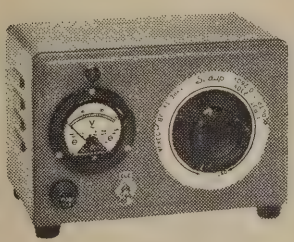
2.5 Amp. ...	**£5.17.6**
5 Amp. ...	**£9. 0.0**
10 Amp. ...	**£18. 5.0**
20 Amp. ...	**£32.10.0**



Inset shows latest type brush gear providing 1 volt variation.

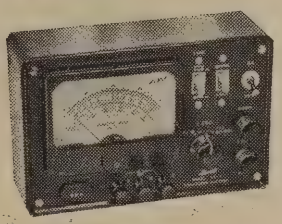
PORTABLE VARIABLE A.C. POWER SUPPLY UNIT

Output: 0–260 v. 1½ amps.
Input: 230 v. A.C. 50/60~.
Unit fitted with fuse, voltmeter, safety indicator, on-off switch and lead.



PRICE **£7.15.0**

TRANSISTOR TESTER



Model AT-1 **£9.17.6**

MEASUREMENT RANGES:
Ico (Icbo) and the reverse current of diodes.
PNP & NPN—0—50μA (1μA per scale)
POWER—0—1mA (20μA per scale)
β5–200 (5 per scale)
Bias current—
(1mA on PNP & NPN)
(5mA on POWER)
α0.9–0.995 (from $\beta = \frac{a}{1-a}$)
Terminals: **Spring Sockets and Screw Terminals.**
Meter: 4in. 50μA moving coil.
Size and Weight: 8in. x 4in. x 8in., 2½ lb.
Powered by Pen-cells.
Reading accuracy ± 3%

TRANSISTORISED MEGOHMETER

BATTERY OPERATED. 500 v.–1,000 Megohms.
This most advanced insulation and continuity tester incorporates these outstanding advantages:
★ One-handed push-button operation.
★ 4in. A.C.-D.C. Voltmeter with fine Zero adjustment.
★ Stable and accurate readings.
★ Easy-to-read scaling.
★ Metal case 7in. x 5in. x 3in.
Complete with probes and carrying case.

ONLY **22 GNS.**

Model MT-500. 500 v. 0–500 megohms insulation Tester.
Mains operated. Suitable for bench use, complete with lead.

25 GNS.

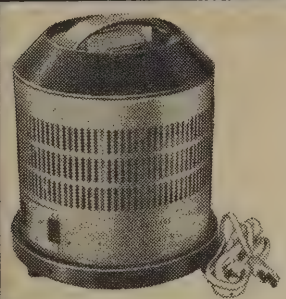
IMMEDIATE DELIVERY

ALL ITEMS FULLY GUARANTEED–CARRIAGE FREE

CONSTANT VOLTAGE TRANSFORMER

DUAL VOLTAGE MAINS STABILIZER

DON'T LET MAINS FLUCTUATIONS SPOIL YOUR TEST READINGS THIS WINTER



Stabilizes mains supply to lab. and test gear, T.V. Hi-Fi tape recorders, etc., especially during winter power shortages at peak periods, and protects them from damage caused by power "surges."

★ Completely protected from damage if appliance is short-circuited, output voltage reduces to nil.
★ NO MOVING PARTS.

Spec.: *Input:* 180–260 v. A.C. and 85–125 v. A.C. *Output:* 240 v. A.C. and 115 v. A.C.—50/60 cycles.

Capacity: 250 v. A. *Accuracy:* ±1%.
Size: 8 x 8in. *Weight:* 21 lb.
Complete with lead and plugs, in attractive vented metal case with leather handle.

£11.10.0

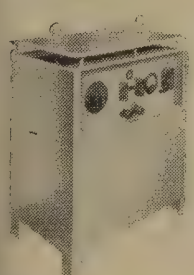
Model SUS-IC

Rating 1kVA.
Fitted with voltage adjustment meter, fuse & indicator lamps.
Complete with lead and plug.

40 GNS

HEAVY DUTY 20 AMP. L.T. SUPPLY UNIT

by S.T.C.

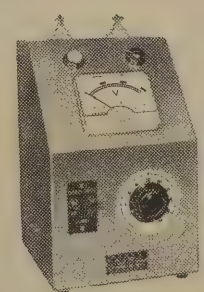


Normal cost over £100. Essential equipment for Electronic Engineering. Research Laboratories, Schools. Ideal for battery charging, etc. Guaranteed for 20 amps.

Output: D.C. variable up to 20 amps. and 24 v. or trickle charge 125/350/700 m A/H.
Input: A.C. 100/260 v. 45/65 cycles.
Size: 16 x 24 x 32in. high. In attractive grey cabinet.

ONLY **£27.10.0**

VARIABLE HIGH-VOLTAGE UNIT



★ *Range:* Infinitely variable up to 3,000 volts and can be accurately set. 0.1 amp.
★ Entirely Suitable for Continuous testing.
★ Built-in Automatic safety cut-out.
Input: Mains voltage.
Robustly constructed for bench use with 4½in. x 4in. modern styled meter, placed at an easy to read angle. Complete with input and test leads with clips.

Model T30, 0–3,000 V.A.C.	**£32.0.0**
Model T50, 0–5,000 V.A.C.	**£40.0.0**

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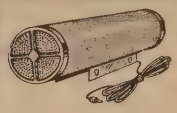
TRANS. RADIO TUBULAR SPEAKER

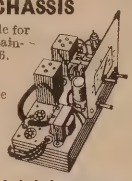


Booster speaker. Plugs into ear-piece socket of most radios and tape recorders. Gives double the volume and a hi-fi stereo effect that will amaze you. Size approx. 9×2½in. PRICE **25/-** P.P. 1/9

HI-FI GT.50 RADIO JACK

MAKE A RADIO RECEIVER OUT OF YOUR AMPLIFIER Full medium coverage. Ideal for all tape recorders, amplifiers, etc. No batteries required—just plug in. ONLY **29/-**

SUPERHET RADIO CHASSIS



These well-made chassis were made for the Government for Forces entertainment with 6K8, 6K7, 6Q7; 6V6. Choke smoothing slow-motion tuning, printed scale, 200–550 metres. BRAND NEW, complete with 6 volt Power Pack. ONLY **57/6** Post 5/-.

Cabinet with 8in. speaker to fit. **27/6** P. & P. 3/-.

LEAD ACID ACCUMULATORS

(Unspillable)

2 volts 16 A.H. Brand new. Size 4×7×2in. **4/11** each, 3 for **12/6**. P. & P. 3/-.

HOOVER ROTARY TRANSFORMERS

12 v. input, 500 v. output at 65mA. or 6 v. input, 250 v. output at 75 mA. PRICE **9/11** P. & P. 3/-.

12 to 250v. CONVERTER UNIT

100 mA. output, double choke smoothed, bridge rectified. Spare vibrator, fuse wire, battery clips, indicator bulbs. Absolutely brand new in maker's cartons. P. & P. 5/-. **30/-**

THREE IMPORTANT RADIO BOOKS

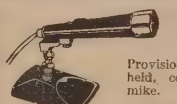
22 tested circuits using micro. alloy transistors **5/6**
Tested short wave receivers using mats..... **5/6**
Tested superhet circuit for short wave communication receiver using mats..... **6/6**

PORTABLE MAINS SOLDERING IRON

30 watts.

Features removable handle that covers tip and barrel. Complete with lead and plug. ONLY **14/11**

SUPERB STREAMLINE MICROPHONE



Omni-directional response 60-10,000 c/s. Output level 52 dB. Built in on/off switch. Provision for conversion to hand held, cord suspended or stand mike.

Attractive satin chrome finish.

MICROPHONE (P. & P. 1/9) **37/6**
DESK STAND (P. & P. 1/9) **10/-**
FLOOR STANDS AVAILABLE.

HIGH IMPEDANCE PERSONAL LISTENING EARPIECES

Suitable for all types of crystal sets and transistor sets. Complete with plug. P. & P. 6d. **5/11**

XONA

SPECIAL OFFER

ON ALL ITEMS ADVERTISED

Constructors' Parcel

★ Any three transistors (not Mat alloy).
★ Any six Highstab resistors (state value required).
★ Any four valve holders and one surprise item.
★ Plus one portable mains soldering iron.

All for **30/-** P. & P. 1/3.

No. 19 TRANSMITTER RECEIVER

Trans/Receiver covers 2-8 Mc/s. (150-37 metres in two bands.) Has an intercom., amplifier. Designed for 12 and 24 volts operation. Uses a 6-valve superhet receiver, I.F. being 465 Kc/s., and a 6-valve transmitter designed for voice and C.W. operation. Incorporates test and tuning meter for voltages, aerial loading and current tests. Panel controls: frequency tuning, P.A. tuning, gain control, MCW., CW., R/T. switch. Het-tone netting. Off-on quench aerial AVC, LT-HT-drives test. ONLY **52/6** No P. & P.

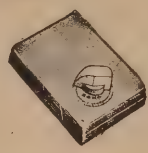
19 SET POWER PACK KIT. P. & P. 5/- Only **39/6**.
19 SET CONTROL BOX. Single type **4/11** each, P. & P. 1/6; Double type **5/11**. P. & P. 1/9.

INSTRUCTION HANDBOOK 3/6. Whip Aerials (U.S.A.), 10ft. **7/6**, P. & P. 2/6; 5ft. **4/-**. P. & P. 1/3.

DOUBLE THROAT MICROPHONE

Can be adapted for use with musical instruments. P. & P. 9d. **4/11**

CRYSTAL SET



Build your own crystal set and hear it work. Easy to build and tune. Picks up main stations. P. & P. 6d. **9/11**

With personal ear-piece, **12/11**.

With headphones, **22/11**. P. & P. 1/9.

TRANSISTOR SALE

Mullard OC 44 (P. & P. 3d.)	3/11
Mullard OC 45 (P. & P. 3d.)	3/11
Mullard OC 71 (P. & P. 3d.)	2/11
Mullard OA 81 (P. & P. 3d.)	1/11
Ediswan XD202 Germanium diodes (P. & P. 3d.)	1/11
Transistor Holder, 3-pin (P. & P. 3d.)	11d. (each)

MICRO ALLOY TRANSISTORS

Mat 100	7/9
Mat 101	8/6
Mat 120	7/9
Mat 121	8/6

Above MATS, postage paid.

Ferrite Slab Aerials, suitable for transistor sets 3/- P. & P. 6d.

METER TEST KITS

Comprising insulated leads and test prods, insulated croc. clips and meter terminal connectors. All contained in plastic hold-all. P. & P. 1/3. **9/11**

Meter Test Prods, **4/11**. P. & P. 9d.

TEST SET 253

Range 20–88 mc/s. in 4 bands. Vernier tuning. Optional pulsed output with fine tuning 50 c/s. mains operation. Noise generator. Strongly made, with metal carrying case. Contains many valuable components: 9 valves, full wave rectifier unit, 3 crystals, meter, mains transformer, numerous switches, chokes. condensers, etc. P. & P. 5/-. **52/6**

RF FIELD INDICATORS

Designed for checking the radiation from a transmitting antenna. The sensitivity can be controlled by adjustment of panel control, the antenna length, or by increasing distance from the radiator. Frequency range 1-250 mc/s. 200uA D.C. **69/6**

FOSTER MIKE (Dynamic type)

Output impedance 600Ω, 10Ω, 50KΩ, ±30%. Effective output level: 58 dB (50 KΩ) ±3 dB at 1,000 c/s. (O dB — 1 v/p bar).
Response: 100-1,200 c/s ±5 dB non directional. Attractive plastic and chrome finish. All necessary accessories for adaption as hand, table or suspended mike 5 feet of PVC cable. **50/-** P. & P. 1/-.

HEAVY DUTY RF CHOKES on STAND

Suitable for transmitting circuits. P. & P. 1/6. **4/11**

MOVING COIL HEADPHONES AND MICROPHONE ATTACHED.
Suitable for 19 set. Not new P. & P. 2/3. **8/11**

CRYSTAL CALIBRATOR TEST SET NO. 7 MK. 1

New in Paxolin cabinet with circuit and instructions on rear panel Calibrates transmitters. AND receivers. 3 choices of calibration points; 10, 100, 1,000 kc/s apart, harmonics up to 20 mc/s. Operates from 2v accumulator and 120v dry battery. **65/-** P. & P. 3/6

COMPONENTS

SMOOTHING CHOKES. 100 m/a., 10–20 H. resistance, 450 ohms. Sturdy metal case. P. & P. 2/6... **4/11**
SMOOTHING CONDENSERS. T.C.C. metal enclosed block condenser, 4½, 2½, 1½in., with terminals. 8 mfd. 350 v. working. Suitable for cross-over units. P. & P. 1/6..... **3/11**
MAINS TRANSFORMER. Mains standard primary 250-0-250 v. 80 mA., 6.3 v. volts at 4 amps., 5 volts at 2 amps. Both tapped at 4 v. P. & P. 2/6. each **18/11**
As above 350-0-350 v. sec. P. & P. 2/6..... **19/11**
FILAMENT TRANSFORMERS. 250–250 v. 50 c/s. primaries. 6.3 v. at 2 amps. P. & P. 1/3.... **6/11**
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CONDENSERS. Variable condenser solid di-electric, .0005 mFd. P. & P. 9d..... **3/3**
TRIMMERS. 0.75C pf. max. P. & P. 3d..... **9d.**
CONDENSERS. 50 mFd. electrolytic reversible, 12 v. working. P. & P. 3d..... **1/3**
1 mFd. **CONDENSERS.** 130 v. working. Suitable as suppressors. **1/11**, P. & P. 9d. 470 pF., 10% tolerance, 750 v. working. **7d.**, P. & P. 3d.

MORSE KEYS. Morse key assembly No. 8. Key with base, cover and terminals. Complete with lead, jack plug, and connector. BRAND NEW. 6/11 P. & P. 2/3

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Large sturdy wirewound variable resistors. Diameter 3½" length (with spindle) 3¾". 3.3 KΩ. Made by Marconi Instruments. **12/11** P. & P. 1/-.

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Special offer. High quality ½-watt resistors. All preferred values (state values required). 10Ω–10 meg ohm. **3½d.** each, 6 for **1/6**, 12 for **2/9**, **24/-** for 100.

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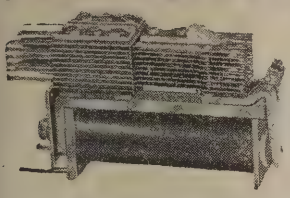

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P.O. TYPE 3000 AND 600
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Contacts up to 8-Changeover

RELAYS MAGNETIC SOLENOID OPERATED

24 volts D.C. 4 make and 4 break 10 amp. contacts. 5C/3944. Brand new, complete, with dust cover, **12/6** each, post 2/-.

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KEY SWITCHES (3 position).
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Other types available, ask for details.

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RACKS—POST OFFICE STANDARD. 6ft. high with U-channel sides drilled for 19in. panels, heavy angle base.
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CONDENSER CLIPS. 11,000 ¾in., 5,000 1in., **16/8** per 100 or offer for the lot.
AUTO TRANSFORMERS by S.T.C. Totally enclosed C core type. 110–250 volts. 8 tappings, 50 cycles, size 6½ × 5¾ × 5½. 500 watts. New latest type **£5**
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SELENIUM METAL RECTIFIERS. FULL WAVE BRIDGE.

12 Volts 1 Amp	**7/6** each	24 Volts 1 Amp.....	**12/6** each
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TELEPHONE SET TYPE "A" Ringing and speaking both ways on a 4-core cable. Very loud and clear over any distance. The handsets are as illustrated and the set is complete except wire. 4-core at **10d.** per yard extra. Price **75/-** set, post 3/6.
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5,000Ω	2CO	M1452	**21/6**
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40Ω	2CO2K	M1482	**22/6**
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180Ω	2m2bHD	M1487	**21/6**
180Ω	2C2K	M1490	**22/6**
670Ω	2C2K	M1493	**22/6**
670Ω	2mHD	M1499	**21/6**
670Ω	4K	M1567	**22/6**
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S.T.C.

45Ω	1mHD	4186EB	**19/6**
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7,500Ω	2CO	N22365AZ1	**21/6**
1.1Ω	4CO	N22364AA1	**22/6**
1.1Ω	2CO2K	N22366AA1	**22/6**
1,500Ω	2CO2K	N22366AE1	**22/6**
2.4Ω	2M	N22371AA1	**21/6**
180Ω	2M	N22371AC1	**21/6**
2,000Ω	2M	N22371AF1	**21/6**
2.4Ω	1m1b	N22370AA1	**21/6**
52Ω	1m1b	N22370AB1	**21/6**
180Ω	1m1b	N22370AC1	**21/6**
1,500Ω	2m2b	N22369AE1	**21/6**
7,500Ω	2m2b	N22369AZ1	**21/6**
1.1Ω	2M2K	N22374AA1	**22/6**
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MILLIAMMETER. 0/100 D.C. 9in. PR. Have a meter you can read easily. **150/-.**
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12/- per dozen 75/- per 100

SINGLE-POLE Double Throw 3 amp. 250 A.C. Can be used as ON/OFF or CHANGE-OVER SWITCH

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A REMARKABLE OPPORTUNITY. Push-pull output. Latest high efficiency Mullard valves: Dual separately controlled inputs for mike and gram. Separate bass and treble controls. High-sensitivity. Output for 3 ohm or 15 ohm loudspeaker. Guaranteed, tested and in perfect working order. For 200-250 A.C. mains.

LINEAR TAPE PRE-AMPLIFIER Type LP/1. Switched negative feedback equalisation. Positions for Record 1¾in, 3¾in., 7½in. and Playback. EM84 Recording Level indicator. Designed primarily as the link between Collaro Tape Transcriptor and high fidelity amplifier but suitable almost any Tape Deck. **9 GNS.** Send S.A.E. for leaflet.

EXTENSION SPEAKERS, in handsome, walnut veneered cabinets. All standard 2-3 ohms, 6½in. 2/9. 8in. 35/9.

CRYSTAL MICROPHONES. Hand type **14/9.** Hand or Desk R.T.C. **19/9.** Acos Mic. 45 **29/9.** Mic. 39 Stick **39/9.** BM3 stick with table stand **59/9.** Lapel type **29/9.**

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER. Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B. Bass and treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohms speaker. Three miniature Mullard valves. Size only 6×5×5¼in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only **£5.19.6** Or Deposit **22/-** and 5 monthly payments of **22/-.** Send S.A.E. for leaflet.

CABY MULTIMETERS. M1. Sensitivity 2,000 ohms per volt. A.C. and D.C. **54/-.** A10. Basic meter sensitivity 155 microamp. A.C. and D.C. ranges. **£4/17/6.** B20. Sensitivity up to 10,000 ohms per volt A.C. and D.C. **£6/10/-.** TMK500 30,000 ohms per volt. A.C. and D.C. **£8/19/6.** Send S.A.E. for leaflet.

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner (specially suitable for use with any of our Amplifiers). Triode Heptrode. F/changer is used. Pentode I.F. and double Diode Second Detector. Delayed A.V.C. W. Ch. Sw. incorporates Gram. position. Controls are Tuning, W. Ch. and Vol. Simple alignment instructions. Only 250 v. 15 mA. H.T. and L.T. or 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost of **£4/15/-.** Point-to-point wiring diagrams and instructions **2/6.**

STOCKISTS OF ARMSTRONG CHASSIS, GOODMANS, W.B. and FANE SPEAKERS, LINEAR, LEAK, VERDIK, ROGERS, DULCI AMPLIFIERS, GARRARD and GOLDRING T/TABLES CASH or H.P.

THE SKYFOUR T.R.F. RECEIVER

A design of a 3-valve 200-250 v. A.C. mains L. and M. wave T.R.F. receiver with selenium rectifier. It employs valves 6K7, SP61, 6V6 and is specially designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point to Point wiring diagram, instructions and parts list **1/9.** This receiver can be built for a maximum of **£4/19/6** including veneered walnut cabinet.

Only 3 pairs of soldered joints plus mains.

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Build a high quality recorder in the £70 class for only

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Can be assembled in 1 hour

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INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIPTOR THE AUDIOTRINE HIGH QUALITY TAPE AMPLIFIER. A HIGH FLUX 7×4in. LOUDSPEAKER. Reel of Best Quality TAPE, Spare Tape Spools, a Portable Cabinet, size approx. 14½×15×8½in., finished in durable and attractive duo tone Policrome and connection diagram for wiring amplifier to transcriptor.

FEATURES INCLUDE:

★ 2-SPEEDS. ★ FREQUENCY RESPONSE 50-11,000 c.p.s. ★ SWITCHED NEGATIVE FEEDBACK EQUALIZING FOR EACH SPEED ★ OUTPUT 4 WATTS ★ MAGIC EYE RECORDING LEVEL INDICATOR ★ 2 MOTORS. ★ Fast rewind ★ TAPE MEASURING AND CALIBRATING DEVICE ★ TAKES FULL 7in. DIAMETER REELS OF TAPE ★ NEGLIGIBLE HUM ★ ENTIRELY EFFECTIVE AUTOMATIC ERASURE. Send S.A.E. for leaflet.

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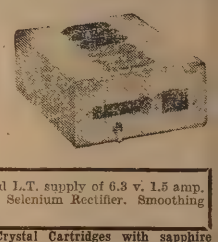
326 Argyle St. (Opening mid-January)

R.S.C. BATTERY TO MAINS CONVERSION UNITS



Type BM1. An all-dry battery eliminator. Size 5½×4½×2in. approx. Completely replaces batteries supply 1.4v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types. Complete kit with diagram **39/9** or ready for use **46/6.** Type BM2. Size 8×5½×2½in. Supplies 120 v. 90 v. and 60 v. 40 mA. and 2 v. 0.4 a. to 1 amp., fully smoothed **THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 2 v. ACCUMULATORS** when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator.

Complete kit with diagrams and instructions. **49/9** or ready for use **59/6.**

POWER PACK KITS. Only **19/11.** Fully smoothed H.T. output of 250 v. 60 mA. and L.T. supply of 6.3 v. 1.5 amp. Consisting of Double Wound Mains Transformer 230/250 v. 50 c.p.s. A.C. primary. Selenium Rectifier. Smoothing Choke. Double Electrolytic Condenser. Aluminium Chassis and Circuit.

GLASGOW 326 Argyle Street

Another Branch Opening late-January

SENSATIONAL STEREO OFFER

Complete kit of parts to construct a 3+3 watt good quality stereo amplifier providing realistic reproduction. Suitable all stereo pick-up heads. Ganged vol. and tone controls. Pre-set balance. For 200-250 v. A.C. mains only. Fully isolated chassis.

4 GNS. Carr. 4/6.

Or including Stereo Head 19/9 extra.

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER KIT

Valves EZ81, ECC 83, ECC83, EL84, EL84. Separate bass and treble controls giving "cut" and "boost." Sensitivity 50 mv, 5 watts high quality output on each channel. Can be used as straight 10 watt amplifier. Controls: Stereo/Monaural switch, ganged volume, ganged treble, ganged bass and balance. Output for 3 ohms speakers. Point-to-Point wiring diagrams and instructions. Illustration full wiring details and priced parts list **1/9.**

8 GNS.

Or supplied assembled and tested 59/6 extra. Carr. 7/9.

ACOS GP67-2G HI-FI Crystal Cartridges with sapphire stylus. Standard replacement for Garrard, B.S.R. and Collaro. Only **16/9.** Acos Stereo/Monaural **35/9.** Ronette Stereo/Monaural **39/9.**

R.S.C. 3 WATT GRAM AMPLIFIER KIT

All parts to construct a very compact, highly sensitive amplifier suitable for any type of single or autochange player. Size 12×2½×2½in. Chassis is isolated. Mains transformer for 200-250 v. A.C. mains. Output for 2-3 ohm speaker. Volume and tone control with mains switch. ONLY **39/9**

GL3A MINIATURE 3 WATT GRAM AMPLIFIERS. For 200-250 v. 50 c.p.s. A.C. mains. Overall size only 11¾ × 2½×2½in. Fitted Vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changer unit. Output for 2-3 ohms speaker. Guaranteed 12 months. Only **59/6.**

SELENIUM RECTIFIERS

L.T. Types	
2/6 v. ½ a. H.W.	1/9
6/12 v. ½ a. H.W.	2/9
Following F.W. (Bridge)	
6/12 v. 1 a.	3/11
6/12 v. 2 a.	6/11
6/12 v. 3 a.	9/9
6/12 v. 4 a.	12/3
6/12 v. 5 a.	14/6
6/12 v. 6 a.	15/6
6/12 v. 10 a.	25/9
6/12 v. 15 a.	35/9

H.T. Types H.W.	
120 v. 40 mA.	3/9
250 v. 50 mA.	3/11
250 v. 60 mA.	4/11
250 v. 80 mA.	6/11
250 v. 250 mA	11/9
Contact cooled	
250 v. 60 mA. H.W.	5/11
250 v. 70 mA. H.W.	7/11
F.W. (Bridge) Types	
250 v. 50 mA.	8/11
250 v. 75 mA.	10/11

R.C.A. 20-WATT RE-ENTRANT SPEAKERS. Matching for 3, 15, 200 and 600 ohms only **4 GNS.**

TRANSISTOR SALE

Mullard OC71 **3/9,** OC45 **4/11,** OC44 **4/11,** OC72 **4/9,** OC81 **4/11,** OC171 **8/9. Ediswan** XA101, XA112 XB113, XB104, XC101A **3/9** ea. Postage 6d. for up to 3 Transistors.

JASON F.M. TUNER

Type FMT1. All parts including Dial, Escutcheon, Punched Chassis &Valves Power supply required 180 v. 25 mA and 6.3 v. 1.5 a. **£7/19/6**

Type FMT2 **£9/17/6**

R.S.C. Battery Chargers & Kits for 200-230-250 v. 50 c/s. A.C. Mains Guaranteed 12 mths.

HEAVY DUTY KIT

6/12 v. variable charge rate up to **6 amps.** Consisting of Mains Trans., F.W. (Bridge), Selenium Rectifier, 0-7 amp. meter. Variable Charge Selector. Fuses, fuse - holders, panels, plugs and circuit. Only **59/9.** Post 4/6.

CHARGER TRANSFORMERS

200-230-230 v. 50 c/s.

0-9-15 v. 1½ a.	12/9
0-9-15 v. 2½ a.	14/9
0-9-15 v. 3 a.	16/9
0-9-15 v. 5 a.	19/9
0-9-15 v. 6 a.	23/9
0-9-15 v. 8 a.	28/9

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, fuse-holders, grommets, panels, clips and circuit. Carr. 3/9 extra.

6 v. or 12 v. 1 amp.	22/9
As above with ammeter	28/9
6 v. 2 amps.	19/9
6 v. or 12 v. 2 amps.	25/9
6 v. or 12 v. 2 amps. (inclusive of ammeter)	35/9
6 v. or 12 v. 4 amps., with variable charge rate selector and ammeter	52/9

HEAVY DUTY 14 AMP KIT

at 12 v. (or 24 v. at 7 amp.). Consists of Transformer, Rectifier, Variable Resistor, Ammeter Fuses, Terminals, Stove Enamelled Case and Circuit. Only **10 GNS.** Carr. 15/-.

ASSEMBLED CHARGERS

6-12v.1a. less meter 27/9

6-12 v. 2 amp Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only **49/9** Carr. 3/9.

6-12 v. 3 amp. with variable charge rate selector and ammeter. **59/9.**

ASSEMBLED 6 v. or 12 v. 4 amps.

Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well ventilated steel case with blue hammer finish. Ready for use with mains and output leads

69/9 Carr. 4/6.

Or Deposit **12/-** and 5 monthly payments of **12/-.** As above but for 6 amp. charging. **4 GNS.** Carr. 5/- or Deposit **16/-** and 5 monthly payments of **16/-.**

D.C. SUPPLY KITS.

Suitable for electric trains. Consists of mains trans. 200-250 v. 50 c.p.s. 12 v. lamp, selenium rect. (F.W. Bridge); 2 fuse-holders, 2 fuses, change direction switch, variable speed regulator, partially drilled steel case and circuit. Very limited number **29/11.**

EX GOVT. SELENIUM RECTIFIERS

12 v. 15 amp. F.W. (Bridge). Only **19/9**

EX. GOVT. SMOOTHING CHOKES

60 ma. 10 h. 400 ohms **3/11.** 100 mA. 10 h. ohms **6/9.** 150 mA. 10 h. 100 ohms **10/11.** 120 mA 12 h. 100 ohms **9/9.** 200 mA. 5 10 h. 100 ohms **11/9.** 250 mA. 5 h. 50 ohms **10/9.**

TANNOY 8 WATT RE-ENTRANT LOUDSPEAKERS. 8 ohms for workshop, factory or outdoor use. **25/9** ea.

VALVES Full range. Keen prices.

CHARGER AMMETERS 0-1½ a., 0-3 a., 0-7a **8/-**

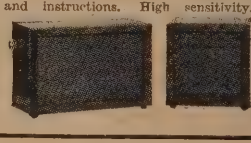
HEAVY DUTY SELENIUM RECTIFIERS

24 v. 20 amp. Full wave (bridge). **49/9** Brand new.

R.S.C. POWER PACKS 200-250 v. A.C. Completely enclosed in louvred enamelled case, 8×5½×2½in. Output fully smoothed 250 v. 60 mA. and 6.3 v. 2 a. **39/9.**

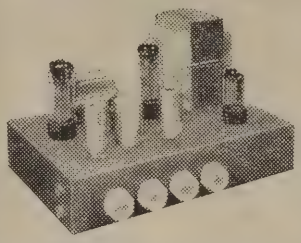
R.S.C. BABY ALARM or INTERCOM. UNIT KIT

For 200-250 v. A.C. mains. Includes all parts, diagrams and instructions. High sensitivity. Completely safe. Controllable at either end. Housed in two cabinets of pleasing design **89/6.** Carr. 5/-. Or assembled and tested **6 gns.**



R.S.C. A10 30 WATT AMPLIFIER

HIGH FIDELITY ULTRA LINEAR PUSH-PULL OUTPUT



SIX VALVES EF86, EF86, ECC83, 807, 807, GZ34. Tone Control Pre-Amp. stages are incorporated. Sensitivity is extremely high. Only 12 millivolt minimum input is required for full output. **THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP.** Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associate vol. control is provided so that two separate inputs such as "mike" and gram. etc., can be simultaneously applied for mixing purposes. **AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20mA and 6.3 v. 1.5 A. FOR A RADIO FEEDER UNIT.** Price in kit form with easy to follow wiring diagram.

ONLY Or factory built using latest EL34 output valves and with 12 Carr. **11 Gns.** month's guarantee. **14 GNS. TERMS ON ASSEMBLED UNITS. 10/-. DEPOSIT 33/9** and 9 monthly payments of **33/9.**

Protective Cover **19/9.** Type 807 output valves are used with High Quality Sectionally Wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. **CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ±3 D.B. 30-20,000 c/s. Tone Controls ± 12 D.B. at 50 c/s. +12 D.B. to −6 D.B. at 12,000 c/s., hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12×9×9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohms speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS, IDEAL FOR USE WITH MUSICAL INSTRUMENTS, SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc. We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. EXPORT ENQUIRIES INVITED.**

LOUDSPEAKERS. 2½in. to 18in. at keen prices. 12in. 6-8 watt 3 ohms **29/11.** 12in. 10 watt 12,000 lines 3 ohms or 15 ohms **59/9. TWEETERS.** 4in. R.A. 3 ohms **25/9.** R.A. 15 ohms **25/9.** W.B. 15 ohms **31/9.** Fane 15 ohms, Pressure type **£3/15/-.**

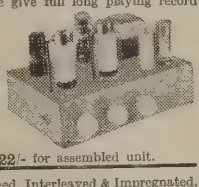
FANE HEAVY DUTY HI-FI SPEAKERS

12in. 15 ohms.	**Cast chassis.**	Exceptionally robust 2in. diam.	Voice Coil Assemblies.
	122/10 20w. .. **5 gns.**	122/10A 20w. .. **6 gns.**	
	122/12 20w. .. **6 gns.**	122/12A 20w. **£7 19 6**	
	122/14 22w. .. **9 gns.**	122/14A 22w. ..**10 gns.**	
	122/17 25w. ..**11 gns.**	122/17A 25w. ..**12 gns.**	
15in. 15 ohms.	**Cast chassis.**	Exceptionally robust 2in. diam.	Voice Coil Assemblies.
	152/12 20w. ..**12 gns.**	152/12A 20w. ..**13 gns.**	
	152/14 27w. ..**14 gns.**	152/14A 27w. ..**15 gns.**	
	152/17 35w. ..**16 gns.**	152/17A 35w. ..**17 gns.**	

"A" indicates dual cone type, 30-17,000 c.p.s. Send S.A.E. for leaflets. Terms available.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIERS

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads in addition to all other types of pick-ups and practically all makes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum-level is negligible being 71 D.B. down. 15 D.B. negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohms speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only **£4/15/-** or assembled ready for use **25/-** extra, plus 3/6 carriage. Or deposit **22/-** and five monthly payments of **22/-** for assembled unit.



R.S.C. TRANSFORMERS Fully Guaranteed. Interleaved & Impregnated.

MAINS TRANSFORMERS. Primaries 200-250 v. 50 c/s.
FULLY SHROUDED. UPRIGHT MOUNTING.

250-0-250v. 60 mA., 6.3 v. 2 a., 0-5-6.3 v. 2a. 2½-3-3in.	17/11
250-0-250 v. 100mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	27/11
360-0-360 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	27/11
300-0-300 v. 130 mA., 6.3 v. 4 a. c.t., 6.3 v. 1 a. For Mullard 510 Amplifier	33/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	33/11
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 5 v. 3 a.	55/-
425-0-425 v. 200 mA., 6.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a.	59/9
450-0-450 v. 250 mA., 6.3 v. 5 a., 4 v. 3 a.	69/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-256 v. 70 mA., 6.3 v. 2 a., 0-5-6.3 v. 2 a.	17/9
250-0-250 v. 100 mA., 6.3 v. 3.5 a.	19/9
250-0-250 v. 100 mA., 6.3 v. 2 a., 6.3 v. 1 a.	21/9
350-0-350 v. 80 mA., 6.3 v. 2 a. 0-5-6.3 v. 2 a.	18/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	26/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	26/9
300-0-300 v. 130 mA., 6.3 v. 4 a., 0-5-6.3 v. 1 a., suitable for Mullard 510 Amplifier	29/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	26/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	29/9
425-0-425 v. 200 mA., 6.3 v. 4 a., 2 v. 3 a.	55/9

MIDGET CLAMPED TYPE. Primaries 200-250 v.

250-0-250 v. 60 mA., 6.3 v. 2 a., 2½×2½×2¼in.	12/9
250 v. 60 mA., 6.3 v. 2 a., Size 2½×2½×2¼in.	11/9

FILAMENT TRANSFORMERS 12 v. 1 a. 7/9

6.3 v. 1.5 a. 5/9	6.3 v. 3 a. 8/11
6.3 v. 2 a. 7/6	6.3 v. 6 a. 17/9
	12v. 3 a. or 24 v. 1.5a. 17/9

AUTO (Step Up/Step Down) TRANSFORMERS

50-80 watts 110-120 v./230-250 v.	13/9
150 watts 110-120 v./200-250 v.	27/9
250 watts 110-120 v./200-250 v.	39/9

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS
HF1012. 10 watts rating. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. **£4/7/6.** Please state whether 3 ohm or 15 ohm required.

BASS REFLEX CABINET. Designed for above speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18×12×10in. Strongly made. Handsome appearance. Ensures superb reproduction for only **£3/19/6.**

OUTPUT TRANSFORMERS

Midget Battery Pentode 66.1 for 3S4, etc.	4/6
Small Pentode, 5,000Ω to 3Ω	4/6
Standard Pentode 5,000Ω to 3Ω	5/9
Standard Pentode 7,000Ω to 3Ω	5/9
Push pull 8 watts EL84 to 3Ω	8/9
Push pull 8 watts EL84s to 15Ω	8/9
Push pull 10-12 watts 6V6 to 3Ω or 15Ω	16/9
Push pull 10-12 watts to match 6V6 to 3-5-8 or 15	17/9
Push pull EL84 to 3 or 15Ω 10-12 watts	17/9
Push pull Ultra Linear for Mullard 510, etc.	29/9
Push pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15Ω	23/9
Push pull 20 watt high-quality sectionally wound, EL34, 6L6, KT66, etc., to 3 or 15Ω fully shrouded	47/9

MICROPHONE TRANSFORMERS

120-1 High quality, clamped	8/9

SMOOTHING CHOKES

250mA., 5 H., 100Ω	11/9	80 mA., 10 H., 350Ω 5/6
150 mA., 7-10H.,250Ω	11/9	60 mA., 10 H., 400Ω 4/11
100 mA., 10 H., 200Ω	8/9	1 amp. 0.5Ω L.T. type 6/6

AUDIOTRINE HIGH FIDELITY SPEAKER SYSTEMS

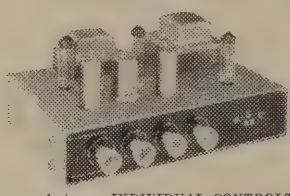
Designed to provide a smooth frequency response from 40-20,000 c.p.s. consisting of 12in. 12,000 line 15 ohm speaker. Crossover Unit and Tweeter. Highly recommended for use with any High Fidelity Amplifier. **10 Watt Unit £4/19/6** or Deposit **11/3** and nine monthly payments of **11/3. 20 Watt Unit £6/19/9** or Deposit **15/9** and nine monthly payments of **15/9.**

B.S.R. MONARDECK TAPE DECKS

Speed 3¾in. per sec. As fitted to most leading make Tape Recorders. Brand new **£8/19/6.** Carr. 5/-. Suitable Portable Cabinets to take Deck and Tape Amplifier **39/9.**

R.S.C. A11 12-14 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram. as in A.10 High sensitivity. Includes 5 valves ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 D.B. 30-30,000 c/s. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs.

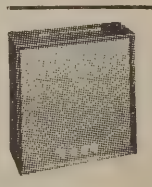
For **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS, etc. OUTPUT SOCKET** with plug provides 300 v. 50 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12×9×7in. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring. Diagrams supplied (or factory built **51/6** extra) ONLY **8 Gns.** Carr. 10/-. If required louvred metal covers with 2 carrying handles can be supplied for **18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9 and 9 monthly payments of 24/9.** Send S.A.E. for illustrated leaflet detailing ready-to-assemble Cabinets, Speakers, Microphones, etc. with cash and credit terms.

R.S.C. BASS-MAJOR 30 WATT GUITAR AMPLIFIER

A Multi-Purpose High Fidelity, High Output Unit for Vocal and instrumentalist Groups. Incorporating two 12in. heavy duty 25-watt high flux (17,000 lines) loudspeakers with 2in diameter pole pieces (total flux 220,000 lines). Designed for efficiently handling more than full output of amplifier at frequencies down to 25 c.p.s. One speaker has an aluminium speech coil and dual cone to extend frequency range up to 17,000 c.p.s.
Heavily made cabinet of convenient size 24×21×14in. has an exceptionally attractive covering in two contrasting tones of Vynair. For 200-350 v. 50 c.p.s. A.C. mains operation. EMINENTLY SUITABLE FOR BASS, LEAD or RHYTHM GUITAR AND ALL OTHER MUSICAL INSTRUMENTS. Four jack socket inputs and two independent vol. controls for simultaneous connection of up to four instrument pick-ups or microphones.
Separate bass and treble controls providing more than adequate "Boost" or "Cut" Level frequency response throughout the audible range.
39½ Gns Carr. 17/6. Or **DEPOSIT £4/3/- and 12 monthly payments of £3/9/11.**
Superior to units at twice the cost. Send S.A.E. for illustrated leaflet.

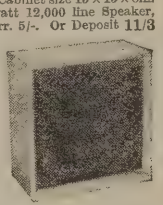
R.S.C. JUNIOR GUITAR AMPLIFIER 5-watt high quality output. Separate base and treble "cut" and "boost" controls. Sensitivity 15 m.v. Two high impedance inputs. 10 in. loudspeaker. Handsome strongly made cabinet (size 14×14×7in. approx.) finished in attractive and durable polychrome. 200-250 A.C. mains operation. **£8/19/6** Carr. Send S.A.E. for leaflet. 7/6. **Or DEPOSIT £1 and nine monthly payments of £1.**

LINEAR TREMOLO/PRE-AMP. UNIT Designed for introducing the Tremolo effect to any amplifier fitted with a reserve power supply point for smoothed H.T. and 6.3 v. A.C. This applies to practically all amplifiers of our manufacture and to those of several other manufacturers. The unit plugs into power supply point and any input socket of amplifier. Controls are Speed (frequency of interruptions). Depth (for heavy or light effect). Volume, and Switch. Three sockets are for 2 inputs and Foot Switch. Only **4 Gns.**



R.S.C. SENIOR 15 WATT LEAD OR RHYTHM GUITAR AMPLIFIER. High-fidelity push-pull output. Separate bass and treble "cut" and "boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-up can be used at the same time. A heavy duty 20 watt high flux 12in. loudspeaker with cast chassis is used. Cabinet is well made and finished as Junior Model. Size approx. 18×18×8in. **18 Gns.** Or DEPOSIT **35/-** and 12 monthly payments **35/-.** Carr. 10/- Send S.A.E. for leaflet.

LOUDSPEAKERS IN CABINETS



12in. 10 WATT. Walnut Veneered Cabinet size 15×15×8in. approx. High quality 12in. 10 watt 12,000 line Speaker, 3 ohms or 15 ohms. **£4/19/6.** Carr. 5/-. Or Deposit **11/3** and nine monthly payments **11/3**

12in. 20 WATT. High Quality 15,000 line l/speaker 15 ohms in Cabinet finished as above. Size 18×18×8in. **£7/19/6.** Carr. 7/9 or Deposit **17/9** and 9 monthly payments of **17/9.**

15in. 30 WATT. Heavy Duty High Flux Speaker. Suitable for BASS GUITAR. Cabinet 24×21×15in. Heavy construction covered in attractive Rexine and Vynair in two contrasting tones of grey. Only **19½ GNS.** Or Deposit **37/6** and 12 monthly payments **37/6.**

15in. 50 WATT. 14,000 line speaker with 3in. diameter speech coil. 15 ohms Impedance, in Substantial Two-tone Rexine and Vynair covered cabinet of pleasing appearance. Acoustically lined. IDEAL FOR BASS GUITAR. Size 30×24×16in. approx. ONLY **29 Gns.** Or Deposit **£3/15/-** and twelve monthly payments **50/-.**

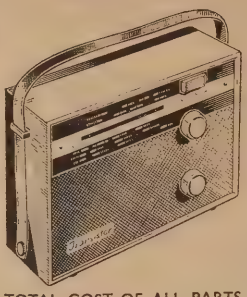
R.S.C. STANDARD BASS REFLEX CABINET. For 12in. Loudspeakers, acoustically lined and ported. Size 20in. × 14in. × 13in. Beautiful walnut veneer finish. Especially recommended for use with Speaker system below, **£5/19/6.** Set of four legs can be supplied with brass ferrules for **19/6.**

AUDIOTRINE CORNER CONSOLE CABINETS. Strongly made. Beautiful polished walnut veneered finish. Pleasing design.

JUNIOR MODEL. To take up to 8in. speaker. Size approx. 20×11×8in. Only **49/9.**

STANDARD MODEL. To take up to 10in. speaker. Size 27×18×12in. **£4/11/9.**

SENIOR MODELS. To take up to 12in. speaker and with Tweeter cut-out. Size approx. 30×30×15in. (Recommended for use with Audiotrine speaker system). **7 Gns.** or terms.



"THE CONTESSA"

★COMBINED PORTABLE AND CAR RADIO ★

AMAZING SENSITIVITY AND SELECTIVITY ON MEDIUM AND LONG WAVEBANDS

★ The easiest Superhet Radio to build on the market. Features clearly marked printed circuit and packaged components with full illustrated building instructions. Full tuning of medium and long wave bands with unbeatable sensitivity and selectivity. Excellent tone and volume with over 600-mW push-pull output. ★ Clearly marked horizontal station dial with slow motion tuning. Two colour Blue or Beige cabinets with Gold handles, grilles and fittings. Sizes 10¾ x 7¾ x 3⅜in., includes car aerial socket, recording sockets. ★ 6 Mullard Transistors and 2 Diodes. **Guaranteed the Best Obtainable**

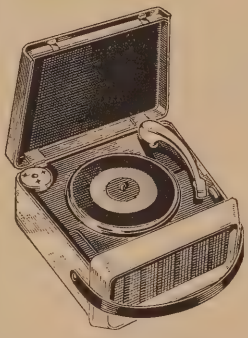
TOTAL COST OF ALL PARTS

£9.19.6 P.P. 3/6.

Fully Detailed and illustrated Leaflet on request.

All parts sold separately.

● **Attractive Appearance—Reliable Design—Unbeatable for Quality and Performance.** ●



"MINI-GRAM" TRANSISTOR PORTABLE RECORD PLAYER

★ **Ready Built 4-transistor 1 watt amplifier with elliptical speaker and volume control, 35/-.** P.P. 2/-.

★ **9 volt 45 r.p.m. turntable with Crystal pick-up, 39/6.** P.P. 2/6.

★ **Two-tone moulded case with handle, 5/-.** P.P. 2/-.

Sold as three pre-built units with less than 30 minutes' interconnection work. Originally sold at more than double the price. A superb record player, fully portable—the ideal gift for teenager or adult.

OR TOTAL COST 79/6 P.P. 5/-.

(Battery 3/9 extra)

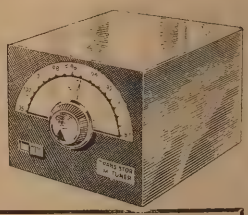
NEW ## VHF TRANSISTOR FM TUNER

See Dec. 'Radio Constructor'

★ **5 Mullard VHF transistors and 4 diodes.**
★ **A.F.C. and A.V.C.**
★ **Tunes 87 to 105 Mc/s.**
★ **Printed circuit.**
★ **Prealigned I.F.T.s.**

New high gain low noise compact design. 9-volt operated. Output for value or transistor amplifiers.

★ **DETAILS ON REQUEST** ★



TOTAL COST OF ALL PARTS **£8.19.6** P.P. 2/6

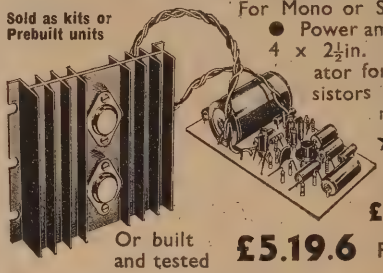
★ Size 3½ × 2⅛ × 4".

ALL PARTS SOLD SEPARATELY AND FULLY GUARANTEED

---

10 WATT TRANSISTOR HI-FI AMPLIFIER AND PRE-AMPLIFIER

Sold as kits or Prebuilt units



For Mono or Stereo equipment.

● Power amplifier built on to 4 x 2½in. panel with radiator for outputs. 6 transistors and rectifier: mains or battery.

★ Complete Kit for 24 volt 3 ohm version.

£5.10.0 P.P. 2/6

Or built and tested **£5.19.6** P.P. 2/6

Mains unit **69/6** extra—either version.

★ Complete kit for 40 volt 15 ohm version **£5/19/6.** P.P. 2/6.

Or built and tested **£6/10/-.** P.P. 2/6.

● Full function pre-amplifier and control unit on printed panel 9 x 2½in. operates from any voltage 9 to 40 volts. 5 controls. Input selector, Treble Bass, Filter. 1.5mV sensitivity. Inputs for P.U.s, Tuners, Mics., Tape, etc.

Kit **99/6.** P.P. 2/-. Built **£5/10/-.** P.P. 2/-. **(DIAL PLATE 8/6 EXTRA)**

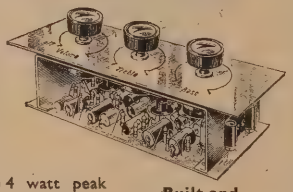
The 24 volt 3 ohm power amplifier can be used on any rectified mains or battery voltage from 4½ to 24 volts. Ideal for loudhailers, public address or equipment amplifiers.

A COMPLETE HI-FI SET UP—ALL TRANSISTOR
● LATEST BOOKLET—FREE ON REQUEST ●
CALL FOR DEMONSTRATION—ANY TIME

- New Fully retractable car aerial tamper proof..... **35/–**
- Transistor Signal injector **39/6**
- Stethoscope Mono Head Sets, Crystal..... **10/6**; Magnetic **10/6**
- Magnetic Stereo Type **27/6**
- 4-Transistor 3 ohm. 9 volt 1 watt amplifier, kit **52/6**; Built **59/6**
- 3 Transistor 125 mW, 9 volt **35/–**
- 5 Transistor 350 mW, 9 volt 150 ohm **57/6**
- 4 Transistor 250 mW, 9 volt 8/10 ohm **39/6**
- Transistor Portable Baby Alarm as previously advertised ... **£5 10 0**
- 5 Hole Chassis, Punch Kit..... **49/6** P. & P. 1/6
- Martin Audio Kits and Record Kits, and add on Preamplifiers available leaflets on request.
- Goodmans, WB and other speakers in stock.
- Crystal Contact Microphone **12/6**

NEW TRANSISTOR, RECTIFIER, VALVE and CRYSTAL CATALOGUE—more types—lower prices 8 page catalogue free on request.

7-TRANSISTOR RECORD PLAYER/ RADIOGRAM AMPLIFIER



- 4 watt peak output.
- Full Treble and Bass boost and cut.
- 40 c/s to 20 kc/s ±3dB.
- Inputs for Pick-ups, Radio Tuners, Microphones, mixers, etc.

Built and Ready to Use

£5.19.6

P.P. 2/-. (Complete with full descriptive Booklet)

Call for demonstration.

● **TWO VERSIONS AVAILABLE**

12/18 volt for 15 ohm speakers (mains unit extra now only **60/-**).

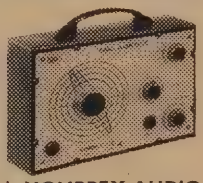
9/12 volt for 3 ohm speakers (mains unit **49/6** extra).

● Size only 6in. x 2½in. x 2in.

Ideal for mains or battery, portable or domestic record player, grams, etc.

● **Booklet Free on Request** ●

PORTABLE TRANSISTORISED TEST EQUIPMENT



★ **NOMBREX AUDIO GENERATOR.** 10 to 100,000 c/s. Sine/square, **£15/2/3**, with batt.

POST AND PACKING 2/6 ANY TYPE

● **DETAILED LEAFLETS ON REQUEST** ●

★ **NOMBREX ALL TRANSISTOR SIGNAL GENERATOR.** 150 kc/s to 350 mc/s. AF, RF Mod. etc., **£7 18/6** with leads, batt., etc.

★ **NOMBREX TRANSISTORISED RESISTANCE CAPACITANCE BRIDGE.** 1pF to 100 mfd. 1 ohm to 100 meg., leakage test, visual null indicator, **£7/2/3** with batt.

★ **NOMBREX TRANSISTOR POWER SUPPLY UNIT.** 1 to 15 volts D.C. up to 0.1 amp. 230/250V. A.C. mains. **£5/17/6.**

★ **TRANSISTOR INJECTOR KIT. 27/6.** P.P. 1/-.
★ **SINCLAIR SLIMLINE, 49/6.** P.P. 1/6.
★ **TRANSISTOR 4-CHANNEL MIXER UNIT, 59/6.**
★ **TAPE JACK TUNER,** Med. Wave, **29/-.** P.P. 1/-.
★ **CHASSIS PUNCH KIT,** 5 piece, ⅛in. to 1⅜in., **49/6.**
★ **HEADPHONES,** 2000 ohm, **12/6**; 4000 ohm, **14/-.**

CINTEL ALL TRANSISTOR COUNTER. Up to 1 Mc/s. **£125.** Brochure on Request.

HENRY'S RADIO LTD.

303 EDGWARE ROAD, PADDINGTON, LONDON, W.2.

OPEN ALL DAY SATURDAY. **100 yards from Edgware Road Tube Station.**

PADdington 1008/9. OPEN MON. TO SAT. 9-6. THURS. 1 o'clock.

● ***CALL IN AND SEE US — ANY TIME*** ● ***ELECTRONIC COMPONENT SPECIALISTS*** ●

68-PAGE FULLY DETAILED AND ILLUSTRATED CATALOGUE
(SIZE 10 x 7½in.) 2/- POST FREE
LET US QUOTE FOR COMPONENTS FOR YOUR CIRCUIT.
(New 8-page Valve, Transistor, Rectifier and Crystal Catalogue now ready 1/-.)

4WW—119 FOR FURTHER DETAILS.

TRANSISTORS, CRYSTALS, VALVES, COMPONENTS & EQUIPMENT

FOR THE AMATEUR AND PROFESSIONAL — QUOTATIONS BY RETURN — TRADE SUPPLIED

MULTI-RANGE TESTMETERS

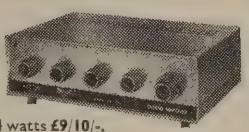
★ PT34	1 K ohm/volt	£2 5	0
★ MI	2 „ „	£2 9	6
★ THL33	2 „ „	£3 15	0
★ EP10K	10 „ „	£4 9	6*
★ ITI-2	20 „ „ (illus)	£5 5	0
★ TP5S	20 „ „	£5 19	6*
★ EP30K	30 „ „	£6 19	6*
★ 500	30 „ „	£8 19	6*
★ EP50K	50 „ „	£9 19	6

* Leather case available.

FIELD STRENGTH METER

Five channels cover 1 Mc/s to 200 Mc/s. Fitted 200 microamp meter for CW or R.F. Indication and Earphone for A.F. monitoring. Designed for checking all types of transmitters. Size 4 x 2¾ x 2¼in. Complete. Ready to Use. with instructions and telescopic aerial, **69/6.** Post Free.

STEREO AMPLIFIERS



Complete with full function pre-amplifiers and controls.

★ SA80 4+4 watts **£9/10/-.**
★ SA150 7+7 watts **£16/10/-.**
★ SA300 15+15 watts **£32/10/-.**

Each amplifier completely self contained and designed for Mono and Stereo output. Supplied complete with full manual. Leaflets on any type on request.

SUBSTITUTION BOXES

- Capacitor Box. Provides 9 standard values from 0.001 to 0.22 mfd. at 600 volt working, **29/6.**
- Resistor Box. Provides 24 standard values at 1 watt. 15 ohms to 10 meg., **37/6.**

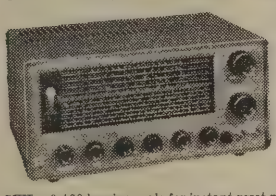
Each box fully calibrated with insulated leads. Invaluable for service and design.

100Kc/s QUARTZ CRYSTALS

2 Pin: OCTAL or 3 Pin	15/- ea.
500 Kc/s. 2 Pin.....	15/-
455 Kc/s. (AR88).....	12/6
HRO 456 Kc/s.....	15/-
5000 Kc/s. 2 Pin.....	10/-
10 Mc/s. 2 Pin.....	15/-
27.255 Mc/s. Radio Control	15/-
HC6U 18 Mc/s. to 46 Mc/s.	7/6
80 frequencies 0.005%	Acc.

Over 600 frequencies in stock. See new crystal lists.

THE HE-30 4-BAND COMMUNICATION RECEIVER



Outstanding Bandspread Selectivity and sensitivity with a built-in Q-multiplier combine to make the HE30 one of the finest general coverage bandspread Receivers available at this price. Covering 550 kc/s-1600 kc/s, 4.8 Mc/s.-14.5 Mc/s., 1.6 cm. 4.8 Mc/s., 10.5 Mc/s-30 Mc/s. For amateur bands an illuminated slide rule dial is provided, calibrated every 5 kc/s. on 80 and 40 metres taking 16 revolutions of the bandspread dial to cover each of these bands every 20 kc/s. on 20 and 15 metres and every 15 kc/s. on 10 metres plus an edgewise S-meter. For the SWL a 0-100 logging scale for instant reset plus coverage from 0.55-30 Mc/s. The 8-valve plus Rectifier superhet circuit provides an RF stage with an Aerial Trimmer for peak performance plus 2 IF stages for improved sensitivity of 1.0 microvolts for 10db S/N ratio The BFO variable pitch control can be used to separate CW stations whilst the Q-multiplier adds the selectivity needed for crowded phone band operation. Controls: Function Switch, Audio Gain, Selectivity (Q-multiplier), Frequency (BFO), Band Selector, IF gain, Trimmer, AVC-MCV Switch, Ant Switch, Main Tuning, Bandspread Tuning and Headphone Jack. Selectivity—60db at 10 kc/s., 0.8 kc/s. at 6 db (with Q-Multiplier), IF—455 kc/s., External P.M. Speaker reqd. 4 or 8 ohms impedance. Output 1.5 watts. 8 modern Miniature B7G Base Valves and 5Y3 Rectifier. Size 15 x 10 x 7¾in. Grey crackle finish. Full instructions and circuit diagram supplied.

40 Gns.
Carr. & Pkg. 15/-.

● LEAFLET ON REQUEST ●

BOAC VHF POCKET RECEIVERS

- ★Features 5-transistors (V6/8R = OC44) 2-OA91 diodes, V.H.F. detector, OA10 rectifier.
- ★1K ohm Stethoscope headset
- ★3.9 volt 450 mA/H rechargeable deac cells.
- ★Moulded case with aerial/strap.
- ★Full circuit and details.
- ●Deac separately, 12/6. P.P. 1/6.
- ●Headset separately, 15/-. P.P. 1/-.
- ●Unit without above cell and phone, 12/6. P.P. 1/6.

●Complete with circuit, 35/-.
P.P. 2/-.

Ideal for experimental receivers—personal locators, etc.

TAPE RECORDER KITS

- COLLARO STUDIO 2-TRACK DECK, 10 Gns. P.P. 5/-.
- 4-TRACK DECK, £13/19/6. P.P. 5/-.
- CABINET with SPEAKER for either of above, 5 gns. P.P. 2/-.
- RECORD/PLAY AMPLIFIER KITS, 2 track, 11 gns. 4 track, 12 gns.

Leaflets on Request.

RECORDING TAPE

3in. 150ft. 5/3; 5in. 600ft. 12/6; 5in. 900ft. 15/-; 7in. 1,200ft. 18/6; 7in. 1,800ft. 25/-; 7in. 2,400ft. 27/6. Excellent quality.

HI-FI SPEAKERS

8A7 15/16 ohm, 6 watt, double cone	79/6
CX300 15/16 ohm, 25 watt, triple cones	12 gns.
CR10AE 15/16 ohm, 20 watt, double cones	8 gns.
CR30AE Triple cone, 20 watt, 15/16 ohm	10 gns.
10 watt Horn Tweeters	29/6

P.P. 1/6.

SR40 OR RX60 4-WAVE-BAND COMMUNICATIONS RECEIVER

4-valve version of HE30—similar in appearance. BFO—bandspread. "S" meter, Noise Limiter, etc. 550 kc/s. to 30 Mc/s. Size 13⅜in. x 8½in. x 5⅜in. Weight 12lbs. **£24/15/-.** Carr. & Pkg. 12/6.

Leaflet on Request.

Cathodeon Miniature Crystal Oven

6 or 12 volt A.C./D.C. 80°C. for HC6U or 2M crystals. Brand new, **22/6.** P.P. 1/-.

- **GS10CS Dekatron Display Tubes 25/-.** Base 2/-.
- **931A Photomultipliers, 60/-, with base.**
- **Large range of Special Valves in stock.**

METER BARGAINS

50 Microamp 2½in. square MC....	35/-
0/100μA 2½in.fr.D.C.	35/-
1 mA. 2½in. flush round.....	30/-

2⅜in. Moving Coil double range Voltmeter, centre zero. 30-0-30 and 3-0-3 volts. Ideal for transistor tester or voltage measurements, 12/6, post free.

0/500μA 2in.....	15/-
0/500μA. 2½in. flush mounting, D.C.	20/-
2½-0-2½ mA., 2½in. flush D.C.	12/6
0/15 volt M.I. 2½in. FR. A.C.	8/6
0/50μA (D.C.) 4in. square, clear front	52/6 p.p. 1/6.

MINIATURE PANEL METERS

*0/50μA (D.C.)	39/6
*0/500μA(D.C.)	32/6
*0/300V(D.C.)	27/6
*0/1 mA (D.C.)	27/6
Vu Meter	42/6
"S" Meter	35/-.

All Brand New Boxed *Available Clear Plastic Front or Black Moulded. State which.

200μA D.C. Edge meter.....	69/6
1mA D.C. Edge meter.....	59/6

3¼ x 1 inch Front Panel.

PORTABLE TRANSISTORISED INSULATION TESTER

MODEL 521

100/250/500 volts at 0/100/200/500 Megohms. Supplied with leads and leather case **£17/10.** P.P. 5/-. Brand new, fully Guaranteed. Leaflet on request.

ZENER REFERENCE DIODES

★ 8 to 8.8 volt, 0.2% stability from —55°C to + 100°C..... **45/- ea.**
★ 5.9 to 6.5 volt. 1% stability from —55°C to + 100°C..... **15/- ea.**

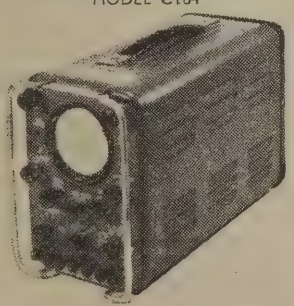
SILICON RECTIFIERS

100 PIV 65 v. RMS 3 amp.....	10/-
400 PIV 280 v RMS 3 amp.....	10/-
600 PIV 420 v. RMS 3 amp.....	17/6
400 PIV 280 v. RMS 1½ amp.....	10/-
100 PIV 45 v. RMS 20 amp.....	35/-

BRAND NEW. COMPLETE WITH INSULATORS, TAGS ETC.

MINIATURE OSCILLOSCOPE

MODEL CT84



High sensitivity 'scope, fully portable with Mullard DG7/5 2⅜in. tube. Gain ±2dB to 2 Mc/s. 10μ sec. to 60 m/sec. sweep. 24 volt operated. Full controls and input facilities, complete in portable cases.

£16/10/-. Carr. & Pkg. 7/6. BARGAIN BUY—LIMITED NUMBER

CRYSTAL MICROPHONES

Range of Dynamic Types in stock. (See Catalogue for details)

Acos 60/1 Stick Microphone	27/6
Acos 39-1 Stick Microphone	32/6
Acos 40 Desk Microphone	15/-
Acos 45 Hand Microphone	25/-
Lapel/Hand Microphone Crystal.....	12/6
100C Stick with Stand fitted muting	39/6
BM3 Stick with Stand fitted muting	52/6
Lapel/Hand Magnetic	12/6

Post and Packing 1/6 any type.

MAINS AND BATTERY RECORD DECKS

★ BSR UA14 4-speed with head	£5 19	6
★ Garrard Autoslim 4-speed „	£6 10	0
★ Unplugable Head Version „	£6 19	6
or Stereo Version „	£7 10	0
★ SRP10 4-speed or BSRGU7 „	£5 5	0
★ Garrard AT6 with Stereo Cartridge, 4-speed.....	£10 19	6
★ AT6 with Mono head.....	£10 10	0

P. & P. 5/- any type above

★ 9 volt Star, 45 r.p.m. with head	39/6
★ 45 and 33 r.p.m. Star, 9V „ „	92/6
★ 45 r.p.m. Garrard, 6V... „ „	35/-
★ 4-speed B.S.R., 9V ... „ „	5 gns.

P. & P. 3/6 any of above.

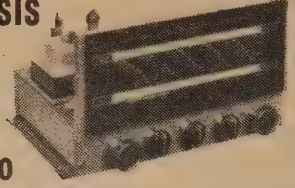
Henry's Radio Ltd.

303 EDGWARE ROAD, LONDON, W.2

PADdington 1008/9

Open Monday to Sat. 9-6. Thurs. 1 o'clock.

ARMSTRONG RADIOGRAM CHASSIS



£21.4.0

AF/208 AM/FM RADIOGRAM CHASSIS

- Full VHF Band (87-108 Mc/s.) Medium Band, 187-570 m.
- 5 watts Output. Perfect quality.
- 15dB Negative Feedback. 7 valves.
- Separate Bass and Treble Controls.
- 2 Compensated Pick-up Inputs.
- Frequency Response 30-22,000 c.p.s. ± 2dB
- Tape Record and Playback Facilities.
- First Class Continental Reception.

For 3, 7½ and 15 ohm Speakers.

BARGAIN SALE PRICES

New boxed VALVES 90-day guarantee.

OZ4	5/-	6K7G	5/-	EB91	4/-	PCL82	10/-
IR5	6/-	6K8G	5/-	EBC41	8/-	PCL84	10/-
IS5	6/-	6L6G	8/-	EBC81	8/-	PL81	10/-
IT4	3/-	6N7M	5/-	EBF80	9/-	PL83	8/-
2X2	2/-	6Q7G	6/-	ECH42	9/-	PY33	15/-
384	7/-	6SN7	5/-	ECH81	9/-	PY80	7/-
3V4	7/-	6V6G	5/-	ECL80	9/-	PY81	8/-
3Q5	7/-	6X4	5/-	ECL82	10/-	PY82	7/-
5U4	6/-	6X5	6/-	EF85	6/-	QP25	7/-
5Y3	6/-	12AT7	6/-	EF89	8/-	SP41	3/-
5Z4	9/-	12AU7	6/-	EL32	5/-	SP61	3/-
6AC7	4/-	12AX7	7/-	EL84	7/-	U22	7/-
6AM6	4/-	12BH7	7/-	EY51	9/-	UBC41	8/-
6AT6	6/-	12K7	5/-	EY86	9/-	UBC81	9/-
6BA6	7/-	12K8	14/-	EZ40	7/-	UBF80	9/-
6BE6	5/-	12Q7	5/-	EZ80	7/-	UCH81	9/-
6BW6	7/-	25Y5G	9/-	EZ81	7/-	UCL82	10/-
6C4	5/-	35L6	9/-	HABC80	10/-	UCL83	12/-
6D6	5/-	35Z4	5/-	HVR2A	5/-	UF89	9/-
6G6	4/-	954	2/-	KT33C	8/-	UL41	9/-
6H6	3/-	DAF96	8/-	KT76	8/-	UY41	7/-
6J5	5/-	DF96	8/-	MU14	7/-	UY85	7/-
6J6	5/-	DK96	8/-	PCC84	8/-	UU9	7/-
6J7G	6/-	DL93	8/-	PCF80	8/-	VR150/30	7/-
6K6	5/-	EABC80	8/-	PCF82	8/-	W81	6/-

NEW ELECTROLYTICS FAMOUS MAKES

TUBULAR	TUBULAR	CAN TYPES
1/350v. .. 2/-	50/350v..... 5/6	8/600v. 9/-
2/350v .. 2/3	100/25v..... 2/-	16/600v. 12/-
4/350v .. 2/3	250/25v..... 2/6	16/450v. 5/-
8/450v. .. 2/3	500/12v..... 3/-	16+16/500v. 7/6
16/450v... 3/-	1,000/12v. .. 3/-	50/450v. 6/6
32/450v... 3/9	5,000/6v. .. 5/-	32+32/350..... 5/-
25/25v. .. 1/9	8+8/450v... 3/6	32+32/450..... 6/-
25/50v. .. 2/-	8+16/450v. 3/9	50+50/350..... 7/-
50/25v. .. 2/-	16+16/450v. 4/3	64+120/350v. 11/6
50/50v. .. 2/-	32+32/350v. 4/6	100+200/275v... 12/6

TINNED COPPER WIRE 16 to 22 s.w.g. ¼ lb. 3/-.
ENAMEL WIRE ½lb. 16 to 22 s.w.g., 2/9, 24 to 30 s.w.g. 3/6, 32 to 40 s.w.g., 4/6. D.C.C. 28, 34, 36 s.w.g. 3/6 2 oz.

CRYSTAL MIKE INSERTS. High output
Miniature size, 1¼in. dia. x ⅝in..... 6/6
ACOS STICK MIKE 39-1..... 35/-
T.S.L. DE LUXE STICK MIKE..... 25/-
TELEPHONE CONTACT MIKE ... 10/6
GUITAR CONTACT MIKE 15/6

MORSE KEY 4/6; BUZZER 4/6.
VALVE HOLDERS, EA50 6d. B12A. CRT. 1/3. Eng. and Amer. 4, 5, 6 and 7 pin 1/-.
MOULDED Int. Oct. or Mazda Oct. 6d.; B7G, B8A, B8G B9A 9d. B7G with can. 1/6. B9A with can. 1/9. Ceramic EF50, B7G. B9A, Int. Oct. 1/-. B7G, B9A cans. 1/- each. Valve base plugs B7G, B9A, 2/3 each.

C.R.T. BOOSTER TRANSFORMERS
For T.V. Tubes having heater Cathode short circuit and for T.V. Tubes with low emission, full instructions. Mains input.
LOW LEAKAGE WINDINGS OPTIONAL 25% and 50% BOOST ON SECONDARY.
2 V. OR 4 V. OR 6.3 V. OR 10.3 V. OR 13.3 V (State tube voltage required) ea. 10/6

HEADPHONES, 4,000 ohms 15/- pair.
HEADPHONES, moving coil 100 ohms 10/- pair.
SWITCH Cleaner Fluid, squirt spout, 4/6 tin.
SPEAKER-FRET. Gold, Green or Maroon Cloth 17 × 25in., 5/-; 25/35in. 10/-. Tygan various colours. 52in. wide from 10/- ft.; 26in. wide from 5/- ft. Samples 1/-.
Expanded Metal, Gold, 12x12in. 6/-.

MINIATURE PANEL METERS
Size 1¾in. sq. Precision jewelled bearings, 2% accuracy, silvered dials, fine pointers, zero adjustment.
0-1mA 27/6; 0-5mA 27/6; 0-300 v. 27/6; 0-50μa 39/6; 0-500μa 32/6. "S" meter 35/-.
CABY MULTIMETER MI 54/-
0-1200 v. A.C.-D.C. Ohms 0-100K, etc.

MAINS TRANSFORMERS
200/250 AC Post 2/- each

STANDARD 250-0-250, 80 mA. 6.3 v., 3.5 a., tapped 4 v. 4 a. Rectifier 6.3 v. 1 a. tapped 5 v. or 4 v. 2 a. 22/6
Ditto 350-0-350..... 29/6
MINIATURE 200 v. 20 mA., 6.3 v. 1 a..... 10/6
MIDGET 220v. 45 mA. 6.3 v. 2 a. 15/6
SMALL, 250-0-250 v. 45 mA., 6.3 v. 2 a. 17/6
STANDARD 250-0-250 65 mA., 6.3 v. 3.5 a..... 17/6
HEATER TRANS., 6.3 v. 1½ a..... 7/6
Ditto tapped sec., 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp. 8/6
HEATER TRANS. 6.3 v. 4 a. 10/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a. 22/6
AUTO TRANS. 150 w., 0, 115 v. 200, 230, 250 v. 22/6
AUTO TRANS. 500 w. 0, 115, 200, 230, 250 v. 82/6

PARMEKO MAINS TRANSFORMER. Made for special contract, the ratings can safely be doubled. Guaranteed 2 years. Primary 0-110-210-230-250 v. H.T. 300-0-300 v. 50 mA. LT. 6.3 v. 1.8 a. 17/6.
MULLARD "510" MAINS TRANS. TO SPEC. 33/6

O.P. TRANSFORMERS. Heavy duty 50 mA., 5/6. Small, pentode, 4/6. Miniature 3V4, etc., 5/9. Multi-ratio 7/6. Multi-ratio heavy duty push-pull 10 w., 15/6.
Goodmans heavy duty 10/20 w. 6K push-pull, 30/-.
Estone ultra-linear OT/ML 10 w., Spec. for "510" 45/- 10 w. matching transformer, 3, 7, 15 ohms. 12/6.
INTERVALVE TRANSFORMERS. 3:1, 5:1, 9/- each.
L.F. CHOKES 15/10 H., 60/65 mA., 5/-; 10 H. 85 mA., 10/6; 10 H. 120 mA., 12/6; 10 H. 150 mA., 14/-.
FULL WAVE BRIDGE CHARGER RECTIFIERS. 2, 6, or 12V. 1½ a., 8/9; 2 a. 11/3; 4 a. 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v., for charging at 2, 6 or 12 v., 1½ a., 15/6; 2 a., 17/6; 4 a., 22/6. Free charger circuit.
4 AMP CAR BATTERY CHARGER with Ammeter Leads, Fuse, Case, etc., for 6 v. or 12 v., 69/6. Ready built.

BOOKS (List S.A.E.)

"W.W." Radio Valve Data	6/-
High Fidelity Speaker Enclosures	5/-
Valves Transistors, CRT Equivalents	9/6
At a Glance Valves, CRT Equivalents	3/6
Coil Design and Construction	5/-
Transistor Sub-Miniature Receivers	5/-
TV Fault Finding	5/-
Mullard Audio Amplifier Manual	8/6
Radio Valve Guide, Books 1, 2, 3 or 4 ea.	5/-
Transistor Superhet Receivers	7/6
Practical Radio Inside Out	3/6
Master Colour Code	1/6
Practical Tape Recording Handbook	5/-
Coil Design and Construction Manual	5/-
Radio, TV and Electronics Data Book	3/6
International Radio Stations List	2/6
High Fidelity Stereo Gramophone	5/-
Modern Transistor Circuits for Beginners	7/6
Principles of Colour T.V. (Patchett)	16/-
Boys' Book of Crystal Sets	7/6
Stroboscopic Disc 33, 45, 78 r.p.m.	1/-
Realistic High Fidelity (Hartley)	5/-

CRYSTAL DIODES, G.E.C. 2/-; GEX34, 4/-; OA81 3/-. Crystal Coils HAX, 3/6; HAXL 3/6; DRR2 4/6; DRX1 3/-; CRYSTAL SET BOOKLET 1/-. CRYSTAL SET KIT 12/6. Brimistors CZ1 3/6; CZ2 2/6; CZ3 1/6.

RADIO AND TELEVISION SPARES
All leading makes, volume controls, etc., line output transformers, etc., B.V.A. valves (current and obsolete types). Send S.A.E. for quotation.

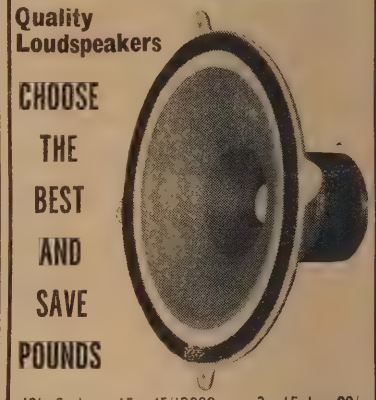
ADASTRA 3-3 AMPLIFIER 3 Watts

ADASTRA 3-3 HI-FI AMPLIFIER READY BUILT, WIRED & TESTED
A.C. only 200-250 V. Valves ECL86 and EZ80. 3 ohms quality output. Mullard tone circuits, Controls: bass boost, treble and volume. Separate engraved front-panel with de luxe finish. Quality mains transformer. Stove enamelled chassis size 6in. x 5in. x 3in. Bargain Price £4/19/6. Details S.A.E.
"Performs agreeably well."
(The GRAMOPHONE)

BAKERS 'Selhurst' RADIO

Quality Loudspeakers

CHOOSE THE BEST AND SAVE POUNDS



12in. Stalwart 15w. 45/12000c.p.s., 3 or 15 ohms 90/-
12in. Stereo, foam suspension, 15 ohms £6/17/6
12in. Standard H.D. 20 w. 40-14,500 c.p.s. £8
12in. De Luxe foam, 15 w. 25-17,000 c.p.s. £9/10
12in. Bass 25 w. 20-18,000 c.p.s. £12/12/-
12in. Ultra Twelve, 20 c.p.s. to 25 kc/s £17/10/-
15in. Baker Bass Auditorium 35 w. Mk. II £18
Ideal for Bass Guitars.
Stalwart Portable Enclosure 18" x 13" x 8" £3.

LOUDSPEAKERS. PM 3 OHM FAMOUS MAKES. 2½in., 3in., 4in., 5in., 6in. × 4in. 15/6 each; 8in. 17/6; 6½in., 16/6; 10in. 30/-; 12in. 30/-; (15 ohms 35/-). 10in. × 6in. 22/6; 8" × 5", 9" × 6", 21/-.
STENTORIAN Tweeter. T359 5 or 15Ω 30/-; Crossover CX3000, 30/-; 10in. HF1012, 87/6; 8in. HF812 72/6.
TWIN GANG CONDENSERS "0-0" Transistor 208pF and 176 pF. with trimmers and screen 10/6 each; 365 pF miniature 1⅛ × 1¼in. × 1⅜in. 10/-; 500pF standard with trimmers, 9/-; midget, 7/6; midget with trimmers, 9/-; 500 pF slow motion drive, standard or midget, 9/-. Small 3 gang, 500 pF., 17/6. Single "0" 365 pF, 7/6.
SHORT WAVE. Single 10 pF, 25pF, 50 pF, 75 pF, 100 pF, 160pF, 5/6 each. Can be ganged together. Couplers 9d. each.
TUNING AND REACTION CONDENSERS. 100pF., 300pF., 500pF., 3/6 each, solid dielectric.
CONDENSERS. 0.001 mfd., 7kV. T.C.C., 5/6; ditto 20 kV. 9/6; 0.1 mfd. 7 kV., 9/6; 100 pF. to 500pF. Micas, 6d. Tubular 500 v. 0.001 to 0.05 9d.; 0.1 1/-; 0.25 1/6; 0.1/350 v., 9d.; 0.5/350 v., 1/9; 0.01/2,000 v., 1/9; 0.1/2,000 v. 3/6.
CERAMIC CONDENSERS, 500 v. 0.3 pF. to 0.01 mfd., 9d. High voltage pulse ceramics, 100pF., etc., 12kv., 2/6.
SILVER MICA. 10% 5 to 500pF., 9d; 600 to 3,000pF. 1/-; close tolerance (plus or minus 1pF), 2.2 to 47pF., 1/-; ditto 1% 50 to 815pF. 1/-; 1,000 to 5,000pF., 1/9.

465-470 Kc/s. SIGNAL GENERATOR
Price 10/6. Uses B.F.O. Unit ZA 30038 ready made with valve 1S5. POCKET SIZE 2¼in. × 4½in. × 1in. Only one resistor to change. Full instructions supplied. Battery 8/6 extra. 69 v. + 1½ v. Details free.

WAVE-CHANGE SWITCHES
2 p., 2-way, or 2 p. 6-way, long spindle 3/6
3 p. 4-way or 1 p. 12-way, long spindle 3/6
4 p. 2-way or 4 p. 3-way long spindle..... 3/6
8 p. 4-way 2 wafer long spindle 6/6
Wavechange "MAKITS" Wafers available; 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way. Prices include click spindles, adjustable stops, etc.
1 wafer, 8/6; 2 wafer, 12/6; 3 wafer, 16/-. Additional wafers up to 12, 5/6 each.
TOGGLE SWITCHES. s.p., 2/-; d.p., 3/6; d.p.d.t., 4/-. Rotary Toggles, s.p., 3/6; d.p. 4/6. Min. Slide D.P. 3/6.
JACKS. English open-circuit 2/6, closed-circuit 4/6. Grundig type 3-pin, 1/3; Grundig Lead Type 3/6.
Phono Plugs 1/-. Sockets 6d.
JACK PLUGS, 3/-. Screened 4/-, Grundig 3-pin 3/6.
BULGIN NON-REVERSIBLE PLUGS and SOCKETS. P74 2-pin 4/3; P73 3-pin 4/6; P194 6-pin 6/6.
P360 3-pin 4/-; Mains selector panel with plug 1/-.

MARTIN TAPE PRE-AMPLIFIERS AND DECKS
(PLAY-BACK THROUGH YOUR OWN HI-FI)
BSR 2 TRACK £8/8/-. TD 2 DECK £6/15/-.
COLLARO 2 TRACK £8/8/-. STUDIO DECK £10/10/-.

COMPLETE RECORDING AND PLAYBACK AMPLIFIERS
2 TRACK BSR £8/8/-. COLLARO £11/11/-.

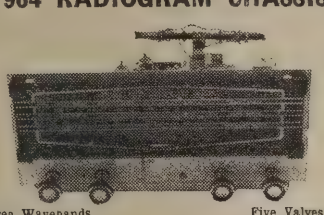
48-HOUR RETURN OF POST MAIL ORDER SERVICE

RADIO COMPONENT

Our written guarantee with every purchase. Buses 133 or 68 pass door S. R. Stn. Selhurst

FOR — IMMEDIATE — DESPATCH — PHONE — US — TODAY

1964 RADIOGRAM CHASSIS



Three Wavebands — Five Valves
S.W. 16 m-50 m. — Latest Mullard
M.W. 200 m.-500 m. — ECH31, EF89, EBC31,
L.W. 800 m.-2,000 m. — EL84, EZ80
12-month guarantee. A.C. 200-250 v. 4-way switch. Short-Medium-Long-Gram. Ferrite Aerial. A.V.C. and Negative Feedback. 5 watts 3 ohm. Chassis 13½in. × 7in. high × 5½in. deep. Glass dial size 13in. × 4in. horizontal wording. Two Pilot Lamps. Four Knobs. Aligned and calibrated. Chassis isolated from mains.

BRAND NEW £9.15.6 Carr. 4/6

Matched Speakers 8in. 17/6; 10in. 25/-; 12in. 30/-.

Volume Controls

Long spindles. Midget 5K ohms to 2 Meg. L/S 3/-. D.P. 4/6.

Stereo L/S 10/6. DP 14/6. Linear or Log Tracks.

80 ohm CABLE Coax

Semi-air spaced 6d. yd.

Fringe Quality, Air spaced. Ideal 625 lines 1/- yd.

CAR AERIALS PLUGS 1/6. Ditto sockets 1/3.
COAXIAL PLUG 1/-. TRIPLEXERS, Bands I, II, III 12/6.
PANEL SOCKETS 1/-. LEAD SOCKET 2/.
COAX. OUTLET BOXES, SURFACE OR FLUSH 4/-.
BALANCED TWIN FEEDER 6d. yd., 80 or 300 ohms.
TWIN SCREENED FEEDER 1/-. 80 ohms.
EXTENSION SPKR. CONTROL. 10 ohms 3/-. 25 ohm 6/6.
TELESCOPIC CHROME AERIALS. 13in. extending to 43in. 8/6 each.
RESISTORS. Preferred values. 10 ohms to 10 meg. ¼ w., ½ w., 4d.; 1 w. 6d.; 1½ w., 8d.; 2 w., 1/-.
HIGH STABILITY. ½ w. 1% 2/- Preferred values, 10 ohms to 10 meg. Ditto 5%, 10 ohms to 22 meg., 9d.

WIRE-WOUND RESISTORS
5 watt, 10-watt, 15 watt — 10 ohms-10,000 ohms — 1/3, 1/6, 2/-
12.5K. to 47 K. 16 w. 3/-

I.F. TRANSFORMERS 7/6 pair
465 kc/s. Slug Tuning Miniature Can. 2×1×1in. High Q and good band width. Data sheet supplied. Standard size Weyrad 1⅞in. sq. × 3¼in., 10/6 pair.

WIRE-WOUND Pots. 3 WATT. Pre-set Min. TV Type. All values 10 ohms to 25K, 3/- ea.; 30K, 4/-; Carbon 30K to 2 meg., 3/-.

WIRE-WOUND 4-WATT STANDARD SIZE POTS. LONG SPINDLE VALUES 50 OHMS to 50K, 6/6; 100K, 7/6.

TRIMMERS. Compression ceramic 30, 50, 70 pF, 9d.; 100 pF. 150 pF. 1/3; 250 pF. 1/6; 600 pF, 750 pF, 1/9; Philips 6 to 10 pF, 3 to 30 pF., 1/- each. T.V. etc. 1000 pF. with knob, 2/-; RADIO SCREWDRIVER, 5in., 6d.
Bulgin Test Prods 2/9 ea. Neosid Trimming tools 1/9.
NEON MAINS TESTER-SCREWDRIVER, 5/-.
SOLDER MULTICORE 4d. yd. SAVBIT DISPENSER 2/6.

HIGH GAIN TV PRE-AMPLIFIER BAND 1 B.B.C.
Tunable channels 1 to 5. Gain 18 dB. ECC84 valve Kit price 29/6 or 49/6 with power pack. Details 6d. (PCC84 valves if preferred).
BAND III I.T.A.—same price.
Tunable channels 8 to 13. Gain 17 dB.
Set of coils and circuit only, 9/6. Band I or III.

PAXOLIN PANELS. ⅛in. × 10in. × 8in., 2/-.
RECTIFIERS. RM1 5/-; RM2 6/-; RM3 8/-; RM4 10/-; RM5 10/-; 14A100 10/-; 14A116 10/-; K3/25 5/-.
MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 mA., 7/6; 250 v. 60 mA., 8/6; 250 v. 85 mA., 9/6; 200 mA., 21/-; 300 mA., 27/6; Full Wave Bridge 250 v. 75 mA., 10/-; 120 mA., 15/-. Silicon 250 v. 450 mA. 10/-.
SELENIUM RECT. Popular type. 300 v. 85 mA., 5/-.
OSMOR MIDGET "Q" type, adj. dust core, from 4/- each.
TELETRON D.W.R. L. and Med. T.R.F. reaction, 4/-. Medium only DR. 4/-. COILS. Wearite "P" type, 4/- each.
FERRITE AERIALS (VALVE) M. 8/9; M.L. 12/6.
FERRITE ROD AERIALS. L. and M. for transistor circuits, OSMOR 10/- each. WEYRAD 12/6 each.
FERRITE RODS 8" × ⅜" × ⅜" 3/-; 6" × ⅜" 3/-; 6" × ⅝" 3/-.

QMAX CHASSIS CUTTER

The cutter consists of four parts; a dia. a punch, an Allen screw and key.

¼in.	14/6	1⅛in.	18/-	2in.	34/3
⅜in.	14/6	1¼in.	18/6	2 3/16in.	37/9
½in.	15/6	1 5/16in.	20/-	2¼in.	44/9
⅝in.	15/9	1⅜in.	20/-	1in. sq.	31/6
¾in.	18/-	1½in.	20/6	1¼in. sq.	28/-
1 5/16in.	18/-	1⅝in.	22/6		

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled, 4 sides, riveted corners, lattice fixing holes, 2½in. sides, 7in. × 4in., 4/6; 9in. × 7in., 5/9; 11in. × 7in., 6/9; 13in. × 9in., 8/6; 14in. × 11in., 10/6; 15in. × 14in., 12/6.
ALUMINIUM PANELS. 18 s.w.g. 12in. × 12in., 4/6; 14in. × 9in., 4/-; 12in. × 8in. 3/-; 1pin. × 7in., 2 8in. × 6in., 2/-. 6in. × 4in. 1/6.

H.F. CHOKES, all wave, 2/6. Osmor QC1 6/9.
T.R.F. COILS A/HF, 7/-; pair BAX 3/6; BAXL 3/6.
REPANCO DRR2 4/6. DRX1 3/-. Purple Cores ⅛in. 6d.
ALADDIN FORMERS and cores. ¼in. 8d., ⅜in., 10d., 0.3in. FORMERS 5937 or 8 and cans TV1 or 2, ⅜in. sq. × 2¼in. or ⅜in. sq. × 1½in., 2/- with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6-1, 4/3.
SOLON IRON 25 w. 200 v. or 230 v., 24/-. 65 w. 29/-.
A.N.T.E.K. PRECISION sub-miniature iron. 200 or 240 v. 29/6. Stands for A.N.T.E.K. irons 12/6 extra.
Spares in stock for above irons.

EAGLE 4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER

Size 3 × 1⅞ × ⅞in.

Powerful, ready built miniature push-pull amplifier with output transformer, 4 transistors. Ideal for use with record players, intercoms., or "BABY ALARM." Complete with full instructions and circuit.

PRICE **47/6** 9 v. Batt. 2/6. 2½in. SPEAKER 15/-

MAINS DROPPERS. Midget. With adj. sliders.
0.3A 1,000 ohms, 5/- 0.15A 1,500 ohms, 5/-.
0.2A 1,200 ohms, 5/-. 0.1A 2,000 ohms, 5/-.

BARGAIN SINGLE PLAYER KIT 200/250 v. A.C.

£5.15.0 (less cabinet) post 5/-

WITH 2-STAGE AMPLIFIER 3-WATT
2 VALVES UCL82, UY85,
HIGH-FLUX 5in. SPEAKER.
4-SPEED E.M.I. TURNTABLE,
16, 33, 45, 78 R.P.M.
CRYSTAL PICK-UP FOR L.P. STD.
RECORDS, 7in., 10in., 12in.
Cut out Mounting board 12⅜ × 9⅞in.

ARDENTE TRANSISTOR TRANSFORMERS
D3035, 7.3 CT:1 Push Pull to 3 ohms for OC72..... 11/-
D3034, 1.75:1 C.T. Push Pull Driver for OC72..... 11/-
D3058, 11.5:1 Output to 3 ohms for OC72 etc..... 11/-
D167, 18.2:1 Output to 3 ohms for OC72, etc..... 12/-
D239, 4.5:1 Driver, ⅜in. × ⅛in. × ⅜in..... 11/6
D240, 8.5:1 Driver, ⅜in. × ⅛in. × ⅜in..... 11/6
ARDENTE TRANSISTOR VOLUME CONTROLS.
VC1545, 5K with switch, 5/3.
VC1760. 5K with switch 10/6.
DEAF AID EARPIECE Xtal or magnetic, 7/6.
SUB-MIN. JACK and PLUG, 3/6 pair.
MIKE TRANSFORMERS 50:1, 3/9.
P.V.C. CONN. WIRE, single or stranded, 2d. yd.
TWIN P.V.C. FLEX, 2 amp., 4d. yd.
SLEEVING 1 or 2 mm. 2d.; 4 mm. 3d.; 6 mm., 5d. yd.
Bib Cutters 3/6. Insulated Side Cutters, 8/6.
Panel mounting fuse-holders 2/-. Fuses 60 mA. to 5a. 6d.

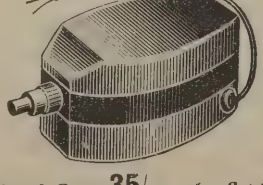
FAMOUS MAKES PLASTIC RECORDING TAPE

Double Play	7in. reel, 2,400ft.	42/-	Spare Spools
	5in. reel, 1,200ft.	25/-	3in. 1/6
Long Play	7in. reel, 1,800ft.	22/6	4in. 2/-
	5½in. reel, 1,200ft.	17/6	5in. 2/-
	5in. reel, 900ft.	15/-	5½in. 2/-
Standard	7in. reel, 1,200ft.	17/6	7in. 2/6
	5in. reel, 600ft.	11/6	Leader Tape 4/6
			Splicer Tape 3/-

"EASYSPLICE" Tape Splicer 5/-.

Screws 1 gross assorted 6BA. 6/6, 4BA. 8/6.
Nuts and Washers 1 gross ea., 6BA 6/6, 4BA 8/6.

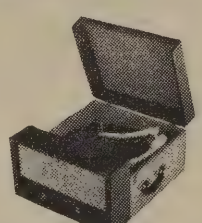
THE "INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETIZER



200/250 v. A.C. **35/-** Leaflet S.A.E.

BUILD YOUR OWN RECORD PLAYER

FROM **£9.19.6** AND SAVE POUNDS



4 Speed Autochange or Single Player units supplied with Brand New 2-tone Portable Cabinets 17 × 15 × 8½in. Strong carrying handle, gilt finish, clips and hinges. As used by Famous Make for 20 gns. models. Ready cut-out motor board 14 × 13in. Front baffle with 7 × 4in. high flux loudspeaker and 3 watt 2 valve UY85, UCL82 2-stage amplifier ready built on metal chassis 12 × 3 × 2½in. Quality 3 ohm output transformer, low hum level circuit. Volume and Tone controls, 3-core safety mains lead. All items fit together perfectly. Special instructions enable assembly in 30 minutes, only 5 wires to join! 12 month written guarantee. Available separately or package deals as below:

AUTOCHANGE KITS Complete—as above.
B.S.R. Monarch UA14 ..... £11/10/- P.P. 5/-
Garrard Autoslim ..... £12/18/0 P.P. 5/-

SINGLE PLAYER KITS Complete—as above.
E.M.I. Junior ..... £9/19/6 P.P. 5/-
E.M.I. auto stop/start ..... £11/5/0 P.P. 5/-

OR SEPARATELY
Cabinet with cut-out board .... £3/9/6 P.P. 3/6
Amplifier with 7 × 4in. speaker £3/17/6 P.P. 3/6

AUTOCHANGERS
B.S.R. UA14 ..... £5/19/6 P.P. 3/6
B.S.R. U.A.15/16 ..... £6/17/6 P.P. 3/6
Garrard Autoslim

SINGLE PLAYERS
E.M.I. auto stop/start ..... £5/10/0 P.P. 3/6
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1U4	5/9	12AV6	6/6	EABC80	5/6	EY86	5/9	U18/20	6/6
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FOR CONTROLLED TEMPERATURE

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Heating time .. .. 20 secs.
"Push-in" Bit Sizes .. 3/32", 1/16", 1/32"
Voltage .. .. 250 to 12 volts
Price **55/-**

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Weight .. .. 4¼ oz.
Heating .. .. 1½min.
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Both Models give excellent bit and element life since the thermostat completely eliminates overheating and controls the reserve heating capacity, which makes possible continuous soldering without chilling of the bit. The consistent temperature makes these irons ideal for printed circuit work.

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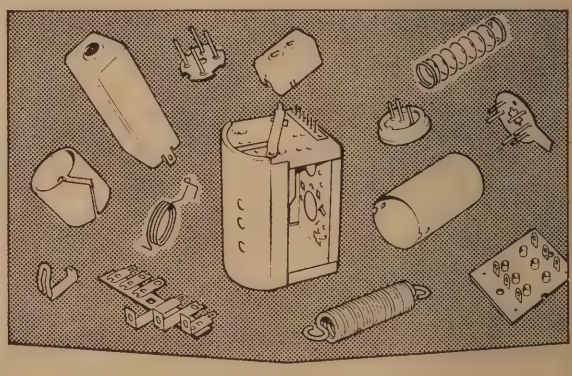

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The "Minigram" Transistorised Record Player

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- ★ Ideal for Teenagers
- ★ For use ANYWHERE
- ★ Hours of amusement for the younger members of the family
- ★ Assemble one of these amazing Players in less than 30 mins., supplied in 3 complete units with only 10 connections to make

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2½	7,000	50	8/6
2½	7,000	80	8/-
3½	8,500(E.M.I.)	3	8/6
3½	7,000	35	8/6
3½	9,500	50	10/6
4	6,000	3	8/-
4	7,000	3	8/6
4	8,000	3	8/6
4	7,000	25	11/6
4	6,000	35	10/6
4	7,000	35	11/-
4	9,500	35	11/6
5	6,000	3	8/-
5	6,000	5	8/-
5	7,000	3	8/6
5	7,000	5	8/6
5	7,500	3	9/-
5	8,500	3	9/6
5	9,500	3	10/6
5	9,500	5	10/6
5	10,000	3	11/6
6½	7,000	3	11/-
6½	7,000	5	11/-
6½	8,500	3	11/6

Elliptical Size in Ins.	Gauss in Lines	Impedance in Ohms	Price
5×3	6,000	3	7/6
5×3	7,000	3	8/-
5×3	9,000	3	8/6
5×3	9,000	4	8/6
5×3	6,000	25	9/6
5×3	7,000	25	10/-
5×3	9,000	25	11/-
6×4	8,500	3	9/6
6×4	9,500	3	10/-
7×3½	9,500	3	10/6
7×4	7,000	3	10/-
8×2½	6,000	3	8/6
8×2½	7,000	5	9/-
8×2½	8,500	5	9/6
8×2½	9,500	3	10/-
8×2½	9,500	4	10/-
8×5	6,000	3	8/6

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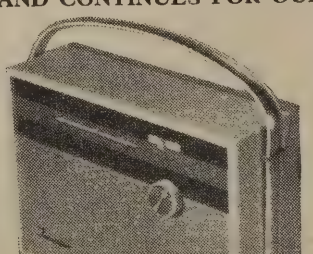

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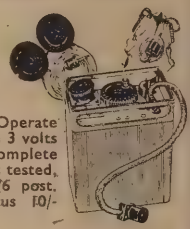

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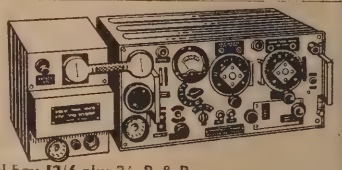

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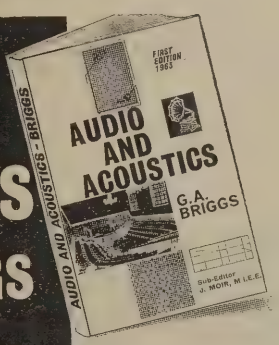

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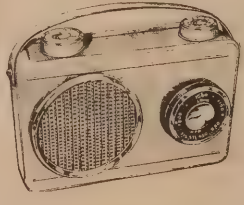

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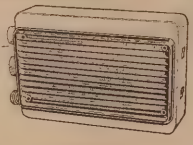

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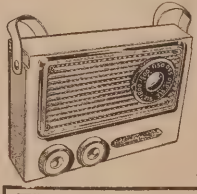

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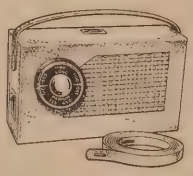

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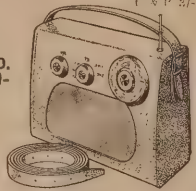

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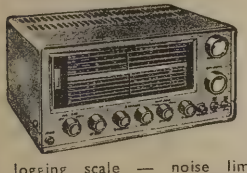

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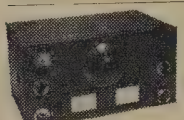

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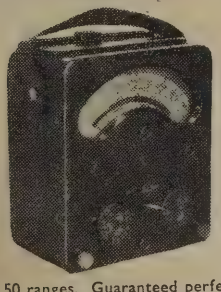

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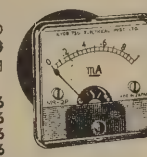


● D'ARSONVAL MOVEMENTS ● JEWELLED MOVEMENTS ● 1 23/32in. SQUARE FRONTS ● 1¼in. OVERALL BEHIND PANEL ● 1¼in. DIA PANEL HOLE ● ACCURACY 2% OF FULL SCALE ● SILVER DIALS, BLACK NUMERALS AND POINTERS ● FRONT ZERO ADJUSTMENT ●

All types moving coil. Individually boxed and guaranteed. Available as follows:

50μA	32/6	1mA.	22/6	300mA.	22/6
100μA	29/6	10mA.	22/6	500mA.	22/6
200μA	27/6	50mA.	22/6	750mA.	22/6
500μA	25/–	100mA.	22/6	1A. D.C.	22/6
50-0-50μA	29/6	150mA.	22/6	5A. D.C.	22/6
100-0-100μA	27/6	200mA.	22/6	3V. D.C.	22/6

10V. DC.	22/6	750VDC.	22/6	150V. DC.	22/6	150V. AC.	22/6
50V. DC.	22/6	15V. AC.	22/6	300V. DC.	22/6	300V. AC.	22/6
100V. DC.	22/6	50V. AC.	22/6	500V. DC.	22/6	500V. AC.	22/6

Calibrated "S" meters **35/-**. A FULL RANGE OF LARGER CLEAR PLASTIC AND BAKELITE PANEL METERS ARE AVAILABLE. SEND FOR ILLUSTRATED LEAFLET. TRADE TERMS AVAILABLE.

FIELD TELEPHONES

Type "L" (illustrated). 2 line connection, generator bell ringing. Complete telephone intercom. Supplied in excellent condition, fully tested and complete with batteries. Only **69/6** per pair. Carr. 5/-.

Type "F" As above but moulded bakelite case. Supplied complete with wooden transit case for field use. **£4/19/6** per pair. Carr. 5/-.

FIELD TELEPHONES TYPE "F"

Suitable for many applications. Generator bell ringing, 2 line connection. With batteries and wooden carrying case, fully tested, **£4/19/6** per pair. Carr. 5/-.

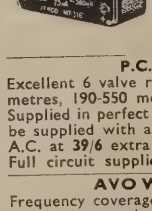
MULTIMETERS

BRAND NEW—FULLY GUARANTEED LOWEST EVER PRICES

Supplied with Leads, Batteries and Instructions.

1,000 Ω/VOLT
0/15/150/1,000 v. A.C. and D.C.
0/150 mA. D.C.
0/100 KΩ etc.
39/6. P. & P. 1/6.

20,000 Ω/VOLT
0/10/50/250/500/1,000 v. A.C. and D.C.
0/50μA/0/25/500 mA. D.C.
0/50K/500K/5 meg., etc. **97/6**.
P. & P. 2/6.



30,000 Ω/VOLT
0/3/1/10/50/250/500/1,000 v. D.C.
0/10/50/250/500 v. A.C.
0/50μA/0/10/250 mA. D.C.
0/10K/1 meg./10 meg. etc. **£5/10/-**. P.P. 2/6.

30,000 Ω/VOLT
0/3/1/2½/10/25/100/250/500/1,000 v. D.C. and A.C.
0/50μA/5/50/500 mA/0/12 amp. D.C.
0/60 K/6 meg./60 meg., etc. **£8/17/6**. Post paid.

50,000 Ω/VOLT
0/10/50/250/500/1,000 v. D.C. and A.C.
0/25μA/2.5/25/250 mA. D.C.
0/10K/100K/1 meg./10 meg., etc. **£7/10/-**.
P.P. 2/6.

100,000 Ω/VOLT
.5/2.5/10/50/250/500/1,000 v. D.C.
2.5/10/50/250/1,000 v. A.C.
10/250μA/2.5/25/250 mA/10 amp. D.C.
20K/200K/2 meg/20 meg. ohm, etc.,
£6/19/6 post paid.

P.C.R.2 COMMUNICATION RECEIVERS

Excellent 6 valve receiver. Frequency coverage on 3 bands, 800-2,000 metres, 190-550 metres and 6-22 mc/s. Output for phone or speaker Supplied in perfect condition **£5/19/6** each. Carr. 10/-. The receiver can be supplied with an internal power supply to operate on 200/250 volt A.C. at **39/6** extra or plug in external power supplies are **35/-** extra. Full circuit supplied.

AVO WIDE RANGE SIGNAL GENERATORS

Frequency coverage 50 kc/s. to 80 mc/s. in six turret operated ranges. For use on standard A.C. mains. Packed in original transit cases with accessories. Supplied in as new condition, fully checked before despatch. **£15**. Carr. 10/-.

MINIFLUX ½ TRACK TAPE HEADS

Set of three, record, playback, erase. Only **29/6** set. P.P. 9d.

MICROAMMETERS

0-500 microamp., 2½in. circular flush panel mounting. Dials engraved 0-15, 0-600 volts. Brand new boxed, **15/-**. P. & P. 1/6.

HEAVY DUTY AUTO TRANSFORMERS

0/115/230 volt step up or step down. Brand new boxed ex-U.S.A. 3,000 watt (**£10/-**, carr. 10/-. 7,500 watt, **£15**, carr. **£1**.

CR.100 COMMUNICATION RECEIVERS

60 kc/s. to 30 mc/s. on 6 bands. 200/250 volt A.C. operation. Supplied in perfect working condition. **£21** each. Carr. 30/-.

FIELD STRENGTH METERS

Frequency coverage 1 to 250 mc/s. Fitted with 200 microamp. meter. Supplied with telescopic aerial, earpiece and instructions. **69/6** post paid.

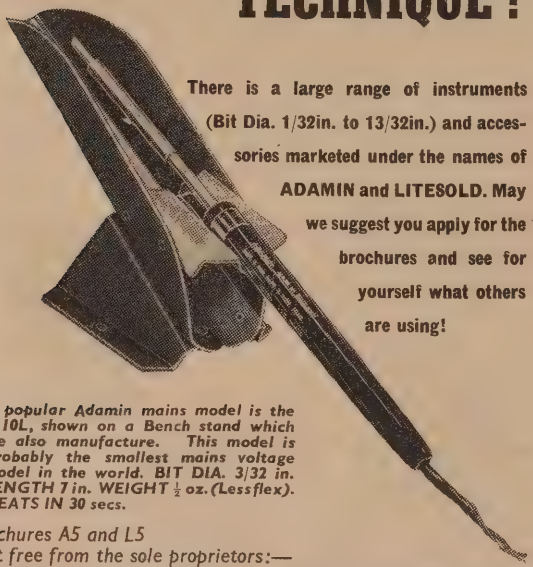
OPEN 9 a.m.-6 p.m. EVERY DAY MON.-SAT

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

4WW—132 FOR FURTHER DETAILS.

ARE YOU UP TO DATE WITH YOUR SOLDERING TECHNIQUE?



There is a large range of instruments (Bit Dia. 1/32in. to 13/32in.) and accessories marketed under the names of ADAMIN and LITESOLD. May we suggest you apply for the brochures and see for yourself what others are using!

A popular Adamin mains model is the C 10L, shown on a Bench stand which we also manufacture. This model is probably the smallest mains voltage model in the world. BIT DIA. 3/32 in. LENGTH 7 in. WEIGHT ½ oz. (Lessflex). HEATS IN 30 secs.

Brochures A5 and L5 post free from the sole proprietors:—

LIGHT SOLDERING DEVELOPMENTS LTD

28 SYDENHAM ROAD, CROYDON, SURREY. Tel: CROydon 8589

4WW—133 FOR FURTHER DETAILS.

WE SPECIALISE IN

EXPORTING

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QUALITY

SOUND EQUIPMENT TO

all parts of the world

All you want in **HI-FI**

TAPE RECORDERS

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AMPLIFIERS

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LOUDSPEAKERS

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ACCESSORIES

Enquiries invited without obligation. We carry large stocks and offer expert service down to the last detail

SEND FOR ILLUSTRATED CATALOGUE $1 POST FREE

MODERN ELECTRICS (EXPORT) (RETAIL) LTD

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Tel: TEM 7587 & GER 9692 Cables: MODCHAREX, LONDON

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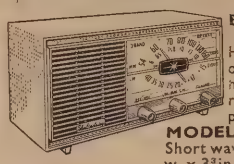
HARVERSON SURPLUS CO., LTD.

For address see opposite page ➔

OUR LATEST BULK PURCHASE!



BRAND NEW A.C. MAINS 5-VALVE SUPERHET RADIO RECEIVERS

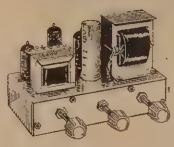
Housed in beautifully styled cabinets offering terrific performance and very high quality reproduction. Built-in ferrite rod aerial for reception of all your favourite programmes. Fully guaranteed.

MODEL 55 (as illus.). Covers Medium, Long and Short waves. Size 8¼in. w. x 3¾in. d. x 4½in. h. **PRICE ONLY £7.17.6** P. & P. 5/6.

MODEL 36. Similar circuitry to above but covers Medium wave only. Size 7⅛in. w. x 3¾in. d. x 4¼in. h. **PRICE ONLY £4.14.6** P. & P. 5/6

(Either of the above can be easily adapted for use as AM feeder unit).

3-VALVE AUDIO AMPLIFIER. MODEL HA34



Designed for Hi-Fi reproduction of records A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x. 4in. d. x 4½in. h. Incorporates ECC83, EL84, EZ80. valves. Heavy duty double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only **£4.5.0** P. & P. 4/-.

TWO VALVE AMPLIFIER similar to above but using ECL82 and EZ80, with tone and volume controls. Output 3 watts. PRICE **75/-**. P. & P. 4/-.

SPECIAL OFFER!

MARCONI QUARTZ CRYSTALS TYPES ZHB

Glass encapsulated, 2 wire lead out. Size 1¼in. high x ½in. dia. Following frequencies (Kc/s.) only available:—

13521, 13583, 13646, 13708,
13771, 13833, 13895, 13958,
14021, 14083, 14146, 14208,
14271, 14333, 14396, 14459.

6/- each. P. & P. 1/- per crystal. 3 or more post free.

4-SPEED PLAYER UNIT BARGAINS

All brand new in maker's original packing.

SINGLE PLAYERS

TU/12 ..... £3/10/-. Carr. 3/6.

AUTO. CHANGERS

B.S.R. UA14 ..... £6/2/6
Latest B.S.R., UA16 ..... £7/2/6

LATEST GARRARD AUTO-SLIM with heavy duty 4-pole motor. FEW ONLY £7/7/-. (Standard Auto-Slim £6/17/6.) Carr. 5/- on each.

SPECIAL TRANSISTOR BARGAINS ALL BRAND NEW

GET 15 (Matched Pair) 15/-
OC71 ... 5/- PXA101 ... 6/6
OC72 ... 6/- XA103 ... 6/6
OC76 ... 6/- V15/10p ... 12/6

Set of Mullard 6 transistors, OC44 2—OC45, OC81D matched pair, OC81 25/-.

EDISWAN MAZDA

R.F.1 Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp.; (Equiv. OC44 and OC45) 10/6
R.F.2 Pack: 2-PXA101 I.F., 1-PXA102 Osc.; 1-PXA102 Mixer 12/6

L.F.6 Pack: Consisting of PXB113 Driver, Matched pair PXC171, mounted complete with heat sinks (Equiv. OC81D and OC81)... 12/6

ALL TRANSISTORS POST FREE.

CARTRIDGE BARGAINS!

B.S.R. TC8S High output compatible STEREO CARTRIDGE. Brand new. Complete with Stereo/LP/78 sapphire stylii and universal mounting bracket.

Original list price 44/11. Our price 22/6. P. & P. 1/-.

COLLARO HI-FI STEREO CERAMIC t/o CARTRIDGE Type "C" Complete with universal bracket and stylii for stereo, L.P. and 78. Original list price 59/8. Our price 25/-. P. & P. 1/-.

ACOS GP65/1 T/O MONO CRYSTAL CARTRIDGE. Complete with sapphire stylii and mounting bracket. Limited number only at 12/6. P. & P. 1/-.

Few Still Available

TELEFUNKEN HI-FI STEREO AMPLIFIER

This may be your last opportunity to secure one of these amazing amplifiers —when remaining few are sold no more will become available.

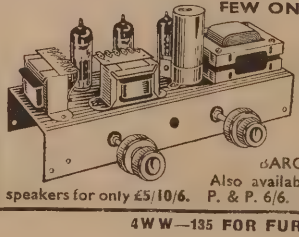
Model S82 with BALANCE CONTROL 110/250 v. A.C. input, 5 watt undistorted output (10 watts nominal).

Size 12 x 9 x 2in. Weight 9 lb. Complete with spec. and instructions. STILL ONLY £5/19/6. Carr. 7/-.

TAPE DECKS

COLLARO STUDIO DECK £10/10/- plus 5/6 carr. and ins. **B.S.R. MONARDECK** (Single speed) 3¾in. per sec., simple control, uses 5¾in. spools, £6/15/0 plus 5/6 carr. and ins. (Tapes extra on both).

FEW ONLY!



STEREO AMPLIFIER

Incorporating 2 ECL82s and 1 EZ80, heavy duty double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.

BARGAIN PRICE **89/6** P. & P 5/-.

Also available complete with two 8in. x 5in. speakers for only £5/10/6. P. & P. 6/6.

4WW—135 FOR FURTHER DETAILS.

SPECIAL PURCHASE! TURRET TUNERS by famous maker

Brand new and unused Complete with PCC84 and PCF80 valves, 34-38 Mc/s I.F. Biscuits for Channels 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY **25/-** each. P.P. 2/6.

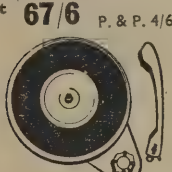
F.M. TUNER HEAD

A permeability tuned tuner head by a famous maker supplied without valve (ECC85) and drum and spindle, **18/6**, plus 1/9 P. & P. Valve **8/6** extra. Drum and spindle **3/6** extra.

GÖRLER F.M. TUNER HEADS

10.7 Mc/s I.F. **15/-**, plus 1/9 P. & P. (ECC85 valve, **8/6** extra).

E.M.I. 4-speed Player and P.U. FURTHER HUGE PURCHASE enables us to offer these at 67/6 P. & P. 4/6.



Heavy 8¾in. metal turntable. Low flutter performance 200/250v. shaded motor with tap at 45v. for amplifier valve filament if required Turnover LP/78 head.

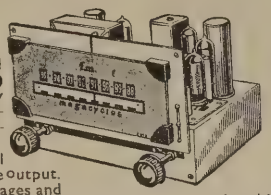
RECORD PLAYER AMPLIFIER

2 valve (EZ80 ECL82), A.C. mains, 3 watts output, ready built tested and complete with valves and output transformer. Size 7in. w. x 2½in. d. x 5¼in. h. **55/-**. P. & P. 3/-. Suitable speakers: 6½in. **15/-**. P. & P. 1/6. 10 x 6in. **26/-**. P. & P. 1/6.

SPEAKER & CABINET FABRICS

Oatmeal, Red and Gold fabrics and various patterns in Vynair and Tygan for speaker and cabinet covering, also Red Rexine for cabinet covering only. All 54in. wide and usually sold at 35/- yard. OUR PRICE **13/6** per yard length. plus P. & P. 1/6. (Minimum order 1 yard) Send S.A.E. for samples.

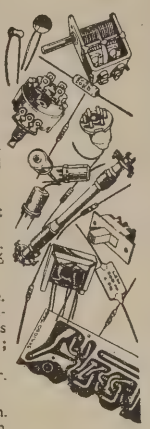
HARVERSON'S F.M. TUNER Mk. I



● F.M. tuning head by famous maker. ● Guaranteed non-drift. ● Permeability tuning. ● Frequency coverage 88-100 Mc/s. ● OA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80s, and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● All parts sold separately. Set of parts if purchased at one time **£5/19/6**, plus 8/6 P.P. and ins. Circuit diagram and instructions 1/6 post free. **Mark II Version** as above but complete with magic eye, front panel and brackets, **£6/12/6**. P. & P. 8/6.

Mark III Version as Mark I but with output stage (ECL82) and tone control. **£7/7/-**. P. & P. 8/6. **Handsome Metal Cabinets.** Choice of Grey, Black or Green. To fit Mark I, **25/-**. P. & P. 2/6. To fit Mark II, **17/6**. P. & P. 2/6.

6 TRANSISTOR AND DIODE SUPERHET



A first-class 2 wavebands transistor superhet. ● Printed circuit panel (size 8⅜ x 2¾in.) ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions.

All parts sold separately. Set of parts if purchased at one time.

ONLY £4.5.0 P. & P. 2/6

35 OHM SPEAKERS

Suitable for use with above. 2in. Goodmans. Ideal replacement for most pocket portables **8/6**; 2½in. **10/6**; 3½in. **12/6**; 5in. **17/6**; 7 x 4in. **21/-**. P. & P. 1/6 per speaker.

Portable CABINET

Size approx. 9½ x 6¾ x 3½in. Suitable for above using 3¼in. speaker, **25/-**. P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 I.F. transformers, one oscillator coil, one driver transformer and wound Ferrite aerial (med., long and aerial coupling), **28/6** complete, post 1/-. 6 transistor printed circuit board to match, **8/6**, post 9d. Circuit diagram **1/6** extra.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (which is used in a 29 gn. record player) employs ECC83, EL84, EZ80 valves. Bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker.

PRICE 69/6 P. & P. 3/6

DITTO. Mounted on board with output transformer and 6in. speaker.

Complete at **89/6**, P. & P. 4/6.

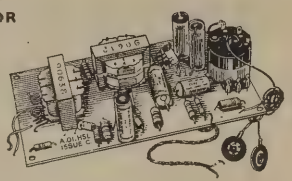
QUALITY PORTABLE RECORD PLAYER CABINET

Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8½in.

PRICE £3/9/6. Carr. 5/-.

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT

Type TA1

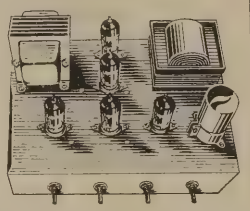


● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET114 or SI Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.

SPECIAL PRICE 45/- P. & P. 2/6

Also ready built and tested, **52/6**. P. & P. 2/6. A pair of TA1's are ideal for stereo.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts).

All parts sold separately. ONLY **£6/19/6**. P. & P. 6/6.

Also available ready built and tested complete with input jack plugs, **£8/15/-**. P. & P. 6/6.

BRAND NEW 3 OHM LOUDSPEAKERS

2½in. **12/6**; 5in. **12/6**; 6½in. **15/-**; 8in. **21/-**; 10in. **25/-**; 12in. **27/6**

E.M.I. 2½in. tweeter **10/6**

8in. x 5in. By famous maker **10/6**

Rola Celestion approx. 9in. x 6in. middle register speaker **10/6**

10in. x 6in. **26/-**

also 15 ohm 12 inch, **30/-**

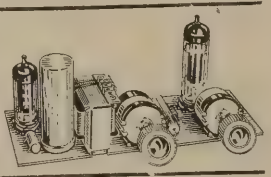
P. & P. up to 6in. **1/6**; over 6in. **2/6** per speaker.

AMPLIFIER CARRYING CASES BRAND NEW

Strongly made wooden construction, tough vynide covered, complete with carrying handle. Overall size 13¾in. wide x 9in. deep x 8in. high with sloping front panel. Weight only 4½ lbs. Ideal for our 10/14 watt amplifier and many others.

BARGAIN PRICE **28/6** P. & P. 4/-.

AMPLIFIER ON PRINTED CIRCUIT BOARD



Two valve. UY85, UL84 O.P. trans., use with 80 volt tap off motor. Only **39/6**. P. & P. 2/6.

Dropper res. for filaments if required. **2/6.**

SUPERIOR CABINET. To take 8 x 5in. speaker, with motor board, will accommodate BSR UA14 or UA16. **£3/9/6.** Carr. 5/6. Speaker **10/6** extra. P. & P. 1/6 extra. **LARGE CABINET**. Similar to above with 3 ohm speaker, **£3/9/6.** Carr. 5/-.

BARGAIN CORNER!!

ACOS CRYSTAL MIKES. High imp. For desk or hand use. High sensitivity, **18/6**. P. & P. 1/6.

TSL CRYSTAL STICK MIKE. Listed at 45/-. Our price **18/6**. P. & P. 1/6.

CARBON MIKE INSERTS. Brand new, 2½in. dia., **3/6**. P. & P. 9d.

STANDARD COLVERN 50K W/W Pre-set Pots. 2 for **4/-**. P. & P. 1/-.

STANDARD 1½in. FUSE HOLDERS. Laminated Twin, 2 for **1/6**. P. & P. 9d. Laminated Single, 2 for **1/-**. P. & P. 6d. Belling-Lee Panel mounting, single, 2/-. each. P. & P. 6d.

TRANSISTOR DRIVER and O/P TRANSFORMERS. (Tapped 3 ohms and 15 ohms output), plus 4 suitable Transistors giving approx. 1 watt output, **30/-**. P. & P. 2/-.

4-WAY NON-TANGLE TELEPHONE CABLE

Latest spring back coil type, extends 12in. to 5ft. Complete with rubber bushes. **3/6** each. P. & P. 1/-.

MAINS TRANSFORMER

Drop thru' type. Tapped primary 110v., 200v., 220v., 240v., 320-0-320v. at 80mA and 6.3v. at 3 amps. Generous core. Stack size 3⅜ x 2⅜ x 1⅜in. Weight 4lbs. ONLY **15/-**. P. & P. 3/6.

8in. x 2½in. 3 ohm SLOT SPEAKERS. Specially designed to handle large output. Ideal for high quality reproduction from limited space. Special purchase, regret no further technical details available but an absolute snip at **8/-** each. P. & P. 1/6 per speaker.

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HF5/HZ ... **£17 5 0.** HAVING TWO MICROPHONE INPUTS.

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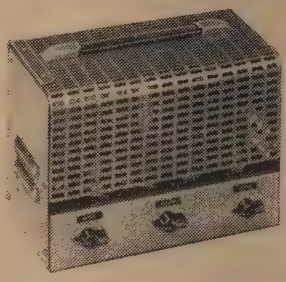

E. K. ELECTRONICS, (I.A.) LTD., Brotherton, Knottingly, Yorks.

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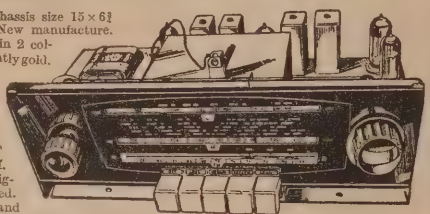
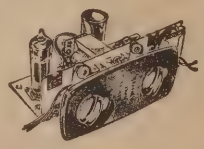
BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £13.13.0 (CARRIAGE PAID)



A.C. ONLY. Chassis size 15 × 6¾ × 5¾in. high. New manufacture. Dial 14¾ × 4in., in 2 colours, predominantly gold. Pick-up, Extension Speaker, Ac., E., and Dipole Sockets. Five "piano" push buttons — OFF L.W., M.W., F.M. and Gram. Aligned and tested. With all valves and O.P. Transformer. Tone Control fitted. Covers 1,000-1,900 M.; 200-500 M; 88-98 Mc/s. Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85. Speaker and Cabinet to fit chassis (table model), **47/6** (post 5/-). 10 × 6in. ELLIPTICAL SPEAKER **25/-** to purchasers of this chassis. TERMS: (Chassis) **£3/10/-** down and 5 monthly payments of **£2/4/-** or with Cabinet and Speaker **£4** down and 6 monthly payments of **£2/4/-**.

ALTERNATIVE DESIGN. LW 1,000-2,000M; SW 17-50M (6-17 mc/s); MW 200-550M; VHF 87-100 mc/s; gram position. Dial dark brown and gold. Otherwise similar to above chassis. Price **£15/15/-** (carr. paid), terms **£3/10/-** down and 6 monthly payments of **£2/4/-**.

STEREO CONVERTER UNIT



Converts existing Radiogram to play stereo records. Chassis 6¾ × 2¾ × 4in. overall height. Mains and O.P. trans., metal rect., ECL 82 valve and all screws, panels, etc. Moulded front escutcheon, fully built, brand new, only extras needed speaker and stereo cartridge. Full instruction leaflet. Two of these units form the basis of an ideal stereo player. Limited quantity at **39/6** (5/6 P. & P.).

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For 4 low consumption valves (96 range), 90 v. 15 mA. and 1.4 v. 125 mA., **45/-** (4/- post). 200-250 v. A.C. Also for 250 mA. 1.4 v. and 90 v. 15 mA. at same price. Two units to replace existing batteries.

TERMS AVAILABLE ON ITEMS OVER £5.
Send 6d. for 20-page illustrated catalogue. All New Goods. Delivered by return. (C.O.D. 2/- extra).
ALL ITEMS GUARANTEED 12 MONTHS. VALVES 3 MONTHS.

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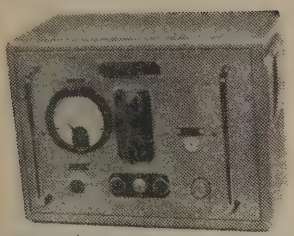

MARCONI TF987/1 NOISE GENERATORS. DETERMINE NOISE FACTOR of A.M. and F.M. receivers. A.C. mains operation. Stabilised H.T. AS NEW. Tested, **£15**, carr. 7/6. SLIGHTLY USED (but tested), **£8/19/6**, carr. 7/6.

MULLARD CRYSTAL CALIBRATOR. In neat grey metal case 9 x 7 x 6½in. Gives 1 Mc/s, 100 Kc/s and 10 Kc/s marker pips and harmonics, as selected. Optional 400 c/s modulation. Complete with five 1T4 and 1R5 valves and 1 Mc/s, B7G glass crystal. Requires 60 v. H.T. and 1.5 v. L.T. In original transit case. **BRAND NEW. £4/19/6.** Carr. 7/6.

COSSOR DOUBLE BEAM OSCILLOSCOPE TYPE 1035
A modern oscilloscope in good working order. Limited number only. **£45.** Carriage 30/–.

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Six turret operated ranges covering 50 Kc/s to 80 Mc/s. For use on standard A.C. mains. Packed in original transit cases with accessories. Post-war type in new condition. **£15.** Carriage 10/–.

MARCONI SIGNAL GENERATOR TF-517. Three ranges. 18 to 58 Mc/s in 2 individually calibrated ranges and 160 to 300 Mc/s by directly calibrated dial. A.C. mains operation. As new condition in original transit cases with instruction book. **£10/10/-.** Carr. £1.

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Vacuum impregnated, interleaved, E.S. screen, universal mounting. Size 4 x 3½ x 2½in. ALL BRAND NEW. **18/6** each. Post 2/6.
Type 1. 250-0-250 v. 80 m/a., 6.3 v. 3 a., tapped at 4 v. 4 a., 6.3 v. 1 a., tapped at 4 v. and 5 v. 2 a.
Type 2. As above, but 350-0-350 v. 80 m/a.
Type 3. 30 v. 2 a., tapped at 12, 15, 20 and 24 v., to give 3-4-5-6-8-9-10 v., etc.
Type 5. 0-5-11-17 v. 4 a. Ideal for chargers.

CO-AXIAL RELAYS. (Switch Type 78A). Simultaneously switch two separate inputs to alternate outputs. 24 volt D.C. coils (can be hand operated). Size (approx.) 5 x 3 x 3in. **8/6.** Post 2/6.

MOVING COIL PHONES. Finest quality Canadian with chamois ear-miffs and leather-covered headband. With lead and jack plug Noise excluding and supremely comfortable. **22/6.** Post 1/6.

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R.C.A. 0-500 microamps. 2½in. circular flush panel mounting. Dials are engraved 0–15, 0–600 volts. As used in the American version of the No. 19 set. **15/-.**

SILICON RECTIFIER. 800 P.I.V. The Modern Marvel. ⅜ x ⅜in. Can be used to replace T.V rectifiers up to 500 mA. (40Ω ballast resistor). **7/6.**

SANGAMO WESTON VOLTMETERS 561. Dual range 0-5 and 0-100 v. D.C. FSD 1 m/A. 3in. scale. Recent manufacture. Ideal for schools. Complete in super quality canvas carrying case, with test prods and leads. **BRAND NEW.** Boxed **27/6.** Post 2/6.

STAR DXER SR-40 £24-15-0

General purpose superhet communications receiver for A.C. mains 220-240 v. covering 550 Kc/s to 30 Mc/s in four switched bands. Slide rule tuning dial, electrical bandspread, internal speaker, panel "S" meter, noise limiter, B.F.O. phone jack; ferrite and whip aerials. Handsome grey crackle cabinet 13½ x 8½ x 5½. Weight 12 lbs. Full instructions manual. **BRAND NEW. CURRENT MODEL.**

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Manufactured by ALMA, RIVLIN, etc Values available 200Ω, 1K, 2.5K, 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1MΩ. 1%—**1/3**, 0.1%—**2/-**, 0.05%—**2/6**. Please add post.

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Dynamometer type. Model 432. Accuracy 1%. 4in. mirror scale. For use on D.C. or A.C. (25 to 1,000 cycles). Ranges 0-350, 700 and 1,400 watts. Max. volts 400. A high quality precision instrument. **BRAND NEW. £9/19/6** P.P.

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AVO. Capacity 5 pfd. to 50 mfd. Resistance 5 ohms to 50 Megohms. Inductance can be measured against external standard. Balance is indicated on a meter which can be used as a valve voltmeter from 0.1 to 15 v. Leakage test and Power Factor scale. A.C. mains operation. Tested and guaranteed and in superlative condition. **£9/10/-**, plus 5/– P. & P.

AR-88 SPARE VALVES. Complete set of BRAND NEW individually boxed original valves (14), **£2/10/-.** P. & P. 2/6.
AR-88 VIBRATOR PACKS. For 6 v. operation. Complete with vibrator and OZ4 rectifier. BRAND NEW in original cartons. **17/6.** P. & P. 2/6.

MAGNETIC COUNTERS (Ex-G.P.O.). 4 figures to 9,999. Coils 500Ω for 24 v. operation Tested (No reset.) **5/-** each. P. & P. 1/6. SPECIAL OFFER. 10 for **30/-**. P. & P. 5/-.

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SEARCH RECEIVER
Type AN/APR4. Covers 38 to 1,000 Mc/s with 3 Plug-in R.F. Heads. TN 16 (38-95 Mc/s), TN 17 (74-320 Mc/s) and TN 18 (300–1,000 Mc/s). Self-contained power supply for 115 v. 50-2-6,000 c.p.s. Thoroughly reconditioned as new. In 100 per cent. mechanical and operational order. **£100.**

ELECTRONIC FREQUENCY COVERTER CV-253/ALR. Ex U.S.A. equipment of recent design (1956). Covers 38 to 1,000 Mc/s in four switched bands as follows: 38 to 130, 130 to 300, 300 to 550 and 550 to 1,000 Mc/s. Can be directly used with the APR-4 search receiver or, if a power supply is provided, into any 30 Mc/s receiver or IF strip. Directly equivalent to all three tuning heads as used in the APR-4. **BRAND NEW. £45.**

PCR COMMUNICATION RECEIVERS
Made by Philips these compact 6-valve receivers incorporate an RF, two IF and a full size output stage for loudspeaker use. There is a phone jack for moving coil phones. All sets are in PERFECT WORKING ORDER and give very fine results on short waves.
TYPE PCR has a self-contained speaker and covers 850 to 2,000, 200 to 550, and 16 to 50 metres.
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USED (GOOD CONDITION) **£5 19 6**
TYPE PCR3. Requires external speaker. Has medium and two short wave bands. Covers 200 to 550 metres. 2.5 and 7 Mc/s (120 to 43 metres) and 7 to 23 Mc/s (43 to 13 metres). **USED (GOOD CONDITION) £8 8 0**
CARRIAGE (any type), **10/6.**
POWER SUPPLIES. The above receivers require 250 volts HT and 12 volts LT. We will supply any of the above receivers fitted with a **BRAND NEW INTERNAL POWER SUPPLY** for **£2** extra. Fully guaranteed ready for use on A.C. mains.

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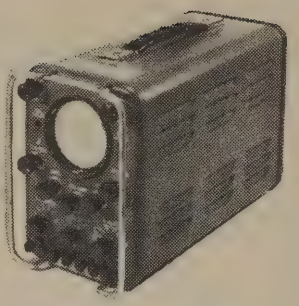

PORTABLE OSCILLOSCOPE CT84. A compact general purpose instrument with many unusual features. Size 9in. high, 8in. wide, 16½in. deep. Time base 10 c/s. to 40 Kc/s. Y plate sensitivity 40V per cm. Tube 2½in. Frequency compensated amplifier up to 38 dB gain. Bandwidth up to 1 Mc/s. Single sweep facilities. As supplied the instrument operates from 24 v. D.C. (A suitable mains transformer will shortly be available which can be directly interchanged with the vibrator transformer). Despatched in metal transit case. As new condition. Tested and guaranteed. **£16/10/-.** Carr. 7/6.

ADVANCE SIGNAL GENERATOR. Type LI. A first grade laboratory type instrument covering 300 to 1,000 Mc/s. Directly calibrated dial. Direct reading attenuator. A.C. mains operation. Pulse and sine wave modulation (variable pulse width). Original price £375. As new. **£120.**

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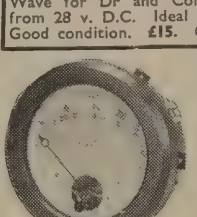
A high frequency version of the well-known BC-221. Accuracy 0.05%. Frequency range 80 to 1,000 Mc/s. As new condition with original calibration book Tested and guaranteed. **£75.**

LM-14 HETERODYNE FREQUENCY METER
Naval version of the BC-221. 125 Kc/s to 20 Mc/s. Undoubtedly superior to the BC-221 in construction and performance. Requires 12 or 24 v. LT and between 200 and 475 v. HT (self stabilised). A particularly useful feature is variable RF coupling and modulation is also available. With correct individual calibration books. Unused and guaranteed. **£25.** P. & P. 7/6. Separate power unit for A.C. (if required). **£4/10/-.** P. & P. 5/-.

SIGNAL GENERATOR CT-53
A precision instrument covering 8.9 to 15.5 Mc/s and 20 to 300 Mc/s in six ranges. Variable attenuator from 1μV to 100 millivolts. AC mains operation. Good condition tested and complete with calibration charts **£16/10/-.** Carr 10/-.

MARCONI AIRCRAFT RECEIVER
Modern type covering 2 to 18.5 Mc/s. Two RF stages, separate oscillator, crystal filter, B7G and B9A valves, turret coil change, film strip scale of fantastic length, scale trimmer (250 Kc/s cal. crystal osc.). Also incorporates Long Wave for DF and Consol. Operates from 28 v. D.C. Ideal for marine use. Good condition. **£15.** Carr. 7/6



FERRANTI VOLTMETERS N5. 0-300 volts, 25-100 c/s. Moving iron. 6in. scale. Fl. mtd. Hermetically sealed. grade 1N. Made 1955. BRAND NEW. Boxed **79/6.** Post 4/-.

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" GEE'S " SUPER QUALITY MESSAGE TAPES 3in. Std. 150ft. **3/9,** 3in. L.P. 240ft. **5/-;** 3in. D.P. 400ft. **10/-.** On brightly coloured spools in neat plastic cassettes. Ideal for gifts or messages.

COLLARO " STUDIO " TAPE TRANSCRIPTORS. Brand new in original cartons. 3 speeds, 1⅞, 3¾, 7½ i.p.s. 3 motors, digital counter, etc. Complete with 7in. spools, instructions and fixings. A.C. 200/230 v. operation. **SPECIAL PRICE 10 GNS.** Carr. paid.

" GEE'S " ACCESSORY KIT 1 " BIB " Splicer, 1 Splicing Tape, 3 Leader Tapes (3 colours), 10 Retaining Clips, Packed in plastic container. PRICE **32/6.** While stocks last.

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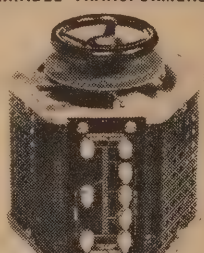
MICROPHONE FLOOR STAND (Telescopic). HEAVY 9in. dome, chromium base, chromium stand with screw top. Extends to approx. 6ft. **55/-.** Carr. 5/-.

15 WATT TRANSISTOR POWER AMPLIFIER A new transistor Audio Frequency Amplifier of new modern design incorporating a number of additional practical features. Operates on 12 volts. Power output 15 watts. Output impedance 25, 15, or 3.75 ohms. Inputs for mike and gram. Frequency response 100 c/s. to 10 kc/s. Incorporates on/off switch, volume control, tone control, pilot lamp. Complete in pale green hammer finish metal case, size 6 × 3¾ × 5¾in. Weight 4½ lbs. Made in England. Brand new and fully guaranteed. All parts replaceable. **ONLY £21.**

'POWERSTAT' VARIABLE TRANSFORMERS

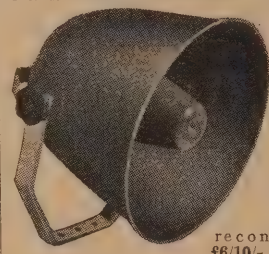


Input 230 volts. 50/60 cycles. Output 0-260 volts at 9 amps. Fully shrouded. For bench or panel mounting. A robust job of outstanding quality and performance. Brand new and guaranteed. **£15.** Carr. 7/6. Made in U.S.A.

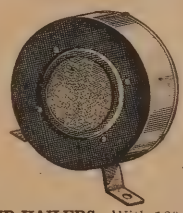
AUTO TRANSFORMERS. Step up, step down, 110/115, 220/230 v. Fully shrouded terminal block connectors. 150 w. **32/6;** 300 w. **47/6;** 500 w. **67/6;** 750 w. **77/6;** 1,000 w. **90/-;** 1,750 w. **175/-.** Carriage 5/- on each type.

RCA PLATE TRANSFORMERS 190 to 250 v. primary 50-60 cycles. Secondary 1,500-0-1,500 v. or 2,000-0-2,000 v. at 500 milliamps. Brand new and boxed **£6/10/-.** Carriage extra.

P.A. EQUIPMENT



RE-ENTRANT LOUD HAILERS (Ex-Govt.) Heavy duty 20 watts, all-metal, 15 ohms. Dia. 15in., length 15in., (approx.). Brand new and boxed. **£9.** Carr. 10/-. Ditto reconditioned, **£6/10/-.** Carr. 10/-.

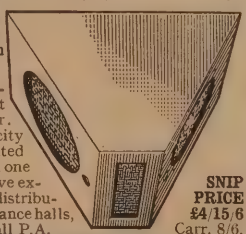


6 inch P.M. HEAVY DUTY SPEAKERS. Complete with line trans., in all steel blue-grey double grilled cabinet, **30/-.** P. & P. 3/-. Ditto, with 10in. P.M. speaker **39/6.** Carr. 6/-.

TRUVOX TANNOY LOUD HAILERS. With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope-front wooden case, **30/-.** Carr. 5/-.

W.B. STENTORIAN 12in. heavy duty 15 ohm. Speaker. Handling capacity 15-20 w. Listed £10/5/-. **OUR PRICE £4/15/-.** P. & P. 5/-.

W.B.Stentorian Dual Purpose Speaker System



Incorporates 2 8" 3 ohm speakers and 100 volt line transformer. Handling capacity 10 watts. Mounted back to back in one cabinet they give excellent sound distribution. Ideal for dance halls, factories, and all P.A. systems. **LIMITED QUANTITY ONLY.** **SNIP PRICE £4/15/6** Carr. 8/6.

100,000 O.P.V. MULTI-TESTER MODEL 370-N

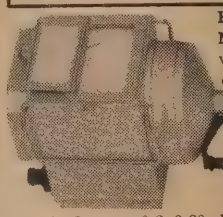
£14.14.0

Incorporates 9.5 μA. basic meter, scale size 4×2½in. Ranges D.C. volts, 8 ranges 100 mV. to 5 kv. D.C. amps., 7 ranges, 10 μA. to 10 A. A.C. volts, 6 ranges 2.5 v. to 1 kv. Ohms 5 ranges 0-50 megohms and 5 ranges 40 ohms to 400 K ohms. Overall size 7×5×2½in.

COSSOR 1035 DOUBLE BEAM OSCILLOSCOPE A fine instrument in perfect condition and in good working order, **£40.** Carr. 30/-.

30,000 o.p.v. MULTI-TESTER MODEL 500 Ranges D.C. volts 0-1,000 v. A.C. volts 0-1,000 v. (15,000 o.p.v.). D.C. current 0-05 500 mA., 0-12 v. Resistance 0-60 megs. Decibel +20 to −56 dB. Sizes 3⅛in.×6⅛in.×2¾in. **ONLY £8/17/6.** Both above supplied complete with instruction manual, test leads and batteries.

MARCONI SIGNAL GENERATOR Type TF517. Covering 10-300 Mc/s in 3 ranges. Complete with coils. LIMITED QUANTITY. Unrepeatable for CALLERS ONLY at **£5** (or **£6/10/-** Carr. Paid.)



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AVO VALVE TESTER. Consists of two parts—valve panel with selector switches and meter with voltage controls, etc. Numerous valve bases including B7G, B8A and B9A This fine instrument supplied in good condition complete with manual. **£10.** Carr. 7/6.

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Model Y.3. 2,000 ohms per volt. Sub-miniature in size and convenient in use. Ranges D.C. volts, 6, 30, 150, 500, A.C. volts, 6, 30, 150, 600. D.C. amps, 150 mA. Ohms, 0-100 K ohms. Size 3⅜×2½×1⅜in. **PRICE 39/6.** P. & P. 2/-.

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ECC35 ... 8/-	EL84 ..... 6/9	N108 .....26/-	R16 .....17/6	UL44 .....20/-	5V4G 7/9	6K8GT ... 9/6	12AU7 ... 5/-	50CD6G 30/-
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ECC84 ... 8/6	EM80 ..... 8/6	OZ4 ..... 5/6	T41 .....15/-	URIC ...15/-	6A7 ..... 9/-	6L18 .....10/-	12C8 ..... 8/6	85A2 .....12/6
	EM81 ..... 8/6	P2 .....10/-	TDD4 ...12/6	UU6 .....17/6	6A8G ... 8/6	6L19 .....15/-	12J5GT ... 4/-	185BT ...30/-
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	EM85 .....10/-		TH41 .....20/-	UU9 ..... 7/6	6AC7 ..... 6/-	6P25 .....10/6	12K7GT... 5/-	807B 7/-
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COMPLETE VALVE LIST FREE WITH ORDER

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RM1 7/6	14A86	23/-	16RD 2-2-8-1	12/- (FC142)
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OC44 ... 6/-	OC74 ... 6/-	OC81D 6/-
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400 volts 350 mA ..... 7/6 each

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IR5, IS5, IT4, 3S4, 3V4..... Set of 4, 19/-
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DAF96 DF96, DK96 DL96 ..... Set of 4, 26/6

TERMS OF BUSINESS C.W.O. or C.O.D.
4/2 PACKING CHARGE ON ALL C.O.D. ORDERS. POSTAGE 6d. per VALVE

4WW—144 FOR FURTHER DETAILS.

15 amp. Thermostat

Adjustable over a fairly wide range of temperatures but set for 70° F. suitable for wall mounting to control room heaters. Exceptional bargain at **9/6**, plus 1/- post and insurance.

Beginner's Superhet

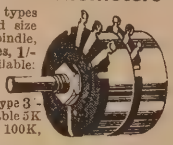
As supplied to many schools and colleges. A simple basic superhet — easy to understand and which can be progressively extended — ideal for students — components include: valves, metal rectifier, tuning condenser, I.F. transformers, etc. In fact complete superhet except speaker. Price **£3** plus 3/- post and insurance. Data included free or sep. 1/6.

Infra-Red Heater

Make up one of these latest type heaters, ideal for bathroom, kitchen, bedroom, etc. They are simple to make from our easy to follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and metal casing as illustrated **19/6** plus 2/6 post and insurance.

Waterproof heater wire. 16 yd. length. 70 watts. Self regulating temperature control, **10/-** post free.

Morganite Potentiometers



Single and 2-gang types available, standard size with good length spindle, all new. **Single types, 1/-** each, values available: 5K, 25K, 50K, 100K, 250K, 1 meg., 2 meg. **Gang type 3 -** each—values available 5K + 5K, 100K. + 100K, 1 meg. + 1 meg.

T.V. CAMERA LENS

16 mm. lens in mount f/3.5 and triple anastigmatic suitable for vidicon tube **£3/10/-**. Post and ins. 2/6.

Copper Clad Element

Mount this under a reflector to make ideal infra red heater, also suitable for building into convector, Blower Heater, drier cabinet, etc., etc., 230/40 v. 1250 watts 12in. long, but can be bent to almost any shape, **7/6** each plus packing and insurance 2/6 extra.

Meter Bargain

2in. Moving Coil 500 micro amp. f.s.d. Brand new **17/6** plus 1/- packing and insurance.

Cabinet Snip

This fine cabinet as illustrated but less control knobs is available this month at a special snip price of **12/6**, plus 3/6 post and insurance Size is 3½in. x 9in. x 4in. and it is nicely covered in two tone I. C. I. fabric.

Yaxley Switches

1 pole, 2 way	2/-;	1 pole, 3 way	2/-
1 pole, 4 way	2/3;	1 pole, 5 way	2/6
1 pole, 7 way	3/-;	1 pole, 9 way	3/-
1 pole, 11 way	3/-;	1 pole, 12 way	3/3
2 pole 2 way	2/3;	2 pole, 4 way	2/6
2 pole. 5 way	5/-;	2 pole, 6 way	3/6
2 pole, 12 way	5/6;	3 pole, 3 way	3/-
3 pole, 6 way	4/-;	3 pole, 12 way	8/6
4 pole, 2 way	3/-;	4 pole, 3 way	3/6
4 pole, 4 way	3/6;	4 pole, 5 way	6/6
4 pole, 6 way	6/6;	4 pole, 11 way	10/6
4 pole, 12 way	11/6	5 pole, 3 way	4/6
5 pole, 6 way	8/-;	5 pole, 12 way	14/6
6 pole, 6 way	9/6;	6 pole, 3 way	4/11
6 pole, 12 way	17/6;	6 pole, 11 way	16/6
6 pole, 4 way	6/6;	8 pole, 2 way	6/6
8 pole, 4 way	7/6	8 pole, 6 way	11/6
8 pole, 12 way	23/6;	12 pole, 2 way	8/-
12 pole, 5 way	16/6;	12 way fader	3/6

1 pole, 6 way incremental shorting **3/6**

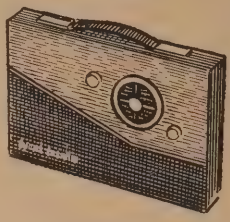
Please add 1/- to cover post and packing on all orders below £3.

CABINET & PICK-UP

Made for a famous company intending to make a battery Record Player but changing their minds. This is an extremely fine looking cabinet, must have cost at least £2 to make. It is complete with handle and fasteners as illustrated. Also included in the parcel is a Cosmocord pick-up with crystal cartridge and sapphire stylus. Both items new and perfect.

ONLY 19/6 Plus 4/6 post and insurance

GOOD COMPANION Mark III



The 6-transistor set with the 8-transistor performance.

Incorporating all the latest refinements. Anyone who can solder can make it.

Many thousands already in use all over the country.

Full coverage of Long and Medium wavebands.

Fine looking cabinet, size 11 × 8 × 3in. Q.P.P. output approx. 750 MW. Excellent reception of difficult stations like 208.

Variable feed back gives excellent tone. **ONLY £5/19/6.** plus 4/- post

THIS MONTH'S SNIP

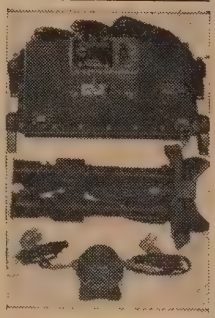
Pocket-sized Tape Recorder. Smallest precision Tape Recorder made—push button control—will record and play back in your pocket—uses standard ¼in. tape and easy to replace batteries. SPECIFICATION. Dimensions 6½ × 2½ × 1⅝in. Weight 14 oz. Recording time 12 mins. Rewinding time 4 mins.

Magnetic erasing. Wow and flutter, within 2% and frequency response 500-1,200 c/s. (within 6 dB).

One month only, **£6.19.6.** plus 2/6 post.

TABBY EQUIPMENT

With details to make Closed Circuit TV Lens System

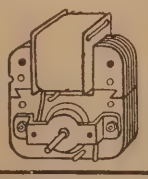


"See in the dark" equipment comprising 5,000 volt power pack which contains ignition coil, vibrator, etc. Control unit interconnecting cables and infra-red binoculars. Offered for one month only at the give-away price of **£3/19/6**, plus 20/- carriage. These are unused, just as received from the Ministry, believed in good working order but sold without guarantee.

MULTI-METER BARGAIN

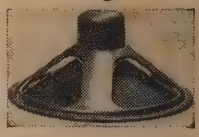
Model number EP10K. Extra wide scale fitted corner-wise for compactness, extra accurate as it uses 1% components. Sensitivity 10,000 ohms per volt. A.C. and D.C. ranges. D.C. voltage up to 1.2kV in 5 ranges. A.C. voltage up to 1.2kV 5 ranges. D.C. current up to 300mA 3 ranges. Resistance up to 2 meg. Capacities 0.05 to .15 mfd and decibels. Complete with full instructions and test prods and battery for ohms range. A real bargain not repeatable once stocks cleared. Price **69/6**. Carriage and insurance 5/-.

MOTOR BARGAIN



Silent running mains motor by very famous maker. Ideal for gramophone, tape recorder, fan, etc., etc., 200-250 volts. A.C. shaded pull start. Size approximately 2¾ × 2¾ × 1¾in. 2,750 r.p.m. Spindle diameter 5/32in. Spindle length ¾in. Brand new guarantee. Price **12/6** plus 1/- post.

Speaker Bargain



12in. High fidelity loudspeaker. High flux permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new, by famous maker. Price **27/6** plus 3/6 post and insurance.

Timer Kit

Special offer of all components except metal box to make mains operated interval timer for photography, etc. **12/6** plus 2/6 post.

5000 mfd Condensers

12v. working—Plessey—perfect **2/-** each 18/- dozen.

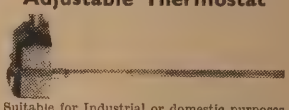
Fluorescent Light Bargain

Kit of parts comprising: choke, two lamp holders, starter holder and starter, 40 watt. **19/6** 80 watt, **27/6**. Plus 2/6 post and insurance.

Building a Scope?

3in. oscilloscope tube. American made type No. 3FP7, base 6.3 v. 6 amp. heater electrostatic deflection, brand new and guaranteed, with circuit diagram of scope, **15/-** each plus 2/6 post and insurance.

Adjustable Thermostat



Suitable for Industrial or domestic purposes such as controlling furnace oven, immersion heater etc. Can also be used as a flamestat or fire alarm. Made by Sunvic these are approximately 17in. long and adjustable over a range 0 to 550°F. The contacts are rated at 15 amps, 230 volts, and the adjustment spindle, which comes to the top, can be fitted with a flexible drive for remote control or just a pointer knob for local control. Listed at **£3** or **£4** each, these are offered only at **8/6** plus 2/6 postage and insurance.

Electric Blanket Spares

We carry a good stock of elements, thermostats and switches etc. for Electric Blankets. Send S.A.E. for list.

Ice-Stat

This is a small thermostat which cuts on and off at around freezing point. Has many uses, one of which could be an ice warning device to be fitted under your motor car. Price **7/6**. Post 1/-.

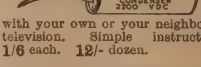
Simmerstat Heater Regulator

Suitable to control elements, heaters, soldering irons and boiling rings up to 2,500 watts. Complete adjustable, normal price 55/- each, special snip price **12/6**, plus 1/6 postage and insurance.

Refrigerator Thermostat

Standard type with adjustment for all normal refrigerator temperatures, **7/6**, 1/- post.

Suppressor Condenser



Stop your drill or other appliances interfering with your own or your neighbours' radio or television. Simple instructions given. **1/6** each. **12/-** dozen.

ELECTRONICS (CROYDON) LIMITED

266 LONDON ROAD, WEST CROYDON

OPPOSITE SAVOY CINEMA

Samson's (ELECTRONICS LTD)

LONDON'S LARGEST SUPPLIERS OF ELECTRONIC EQUIPMENT
9 & 10 CHAPEL STREET,
LONDON, N.W.1.
Tel. PAD 7851 AMB 5125

HEAVY DUTY L.T. TRANSFORMERS

All primaries 220-240 volts. Terminal block connections.

No.	Sec. Taps	Price	Carr.
1	25, 30, 35 v., 40 a.	£11 19 6	10/-
2	25, 30, 35 v., 20 a.	£6 19 6	7/6
3	25, 30, 35 v., 10 a.	£4 15 0	5/-
4	25, 30, 35 v., 2 a.	£1 17 6	3/6
5	10, 17, 18 v., 10 a.	£2 17 6	4/-
6	24 volts, 30 amps.	£7 15 0	7/6
7	20 volts, 30 amps.	£6 15 0	7/6
8	50 volts, 15 amps.	£6 19 6	7/6
9	30 v., 40 v., 50 v., 5 a.	£4 15 0	5/-
10	24, 36, 48 v., 8 a.	£4 19 6	5/-
11	17, 18, 20 v., 20 a.	£4 19 6	5/-
12	6, 12 v., 20 a.	£3 12 6	5/6
13	20 volts, 20 amps.	£4 15 0	7/6
14	30, 32, 34, 36 v. 5 a.	£2 17 6	4/-
15	6, 12 v., 10 a.	£2 2 6	4/-
16	12 volts, 5 amps.	£1 9 6	3/-
17	24 volts, 10 amps.	£3 5 0	4/-
18	24 volts, 5 amps.	£1 19 6	3/6
19	48, 56, 60 v., 1 a.	£1 9 6	3/6
20	12, 24, 30, 48 v., 2 a.	£2 5 0	3/6
21	6.3 volts, 15 amps.	£1 17 6	3/6
22	6.3 v., 5 a., and 6.3 v., 1 a.	15 0	3/6
23	12, 24 v., 1 a.	15 0	2/6
24	9, 15 v., 2 a.	17 6	2/6
25	6, 9, 15 v., 4 a.	£1 5 0	3/6
26	12, 18 v., 10a.	£2 12 7	4/-
27	12, 18 v., 20 a.	£3 19 6	5/-
28	10, 18, 20 v. 9 a.	£3 9 6	5/-
29	15 v. ct. 5 a.	£1 5 0	3/6
30	10-11-12 v., 1½ a.	10 6	2/-

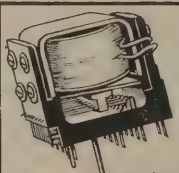
MULTI-TAPPED TRANSFORMERS
Pri. 2,500, 230, 250 volts. Sec. T. 3, 4, 5,6, 8, 9, 10, 12, 15, 18, 20, 24, 30 volts, 5 amps., **45/-**. P.P. 4/-. 4 amp., **39/6**. P.P. 3/-. 2 amp., **25/-**. P.P. 3/-.

A.M. HEAVY DUTY AUTO. STEP-UP OR STEP-DOWN TRANSFORMERS
Designed for the Air Ministry for mains boosting or operating 110 v. equipment. **10KVA.** Tapped 250, 240, 230, 220, 120, 115, 110, 105 volts. Completely enclosed in metal case. Size 27 x 17 x 14in Weight approx. 3 cwt. **£29/10/-. 5KVA.** Tapped as above. Size 23 x 14 x 11in. Weight approx. 2 cwt., **£19/10/-.** All transformers supplied new and guaranteed and offered at a fraction of maker's price. Carr. extra.

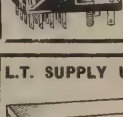
TRANSFORMER UNIT TYPE AP61774
Comprising Parmeko hermetically sealed transformer pri. 230 v Sec. 24 volts very conservatively rated at 2 amps. Built into a metal case* with fitted neon indicators, and fuses. Shielded input and output terminals. Supplied brand new in maker's cartons at a fraction of original cost, **29/6**, carr. 5/-.
*Size 7½ x 4 x 4in.

JUST ARRIVED!! HEAVY DUTY L.T. TRANSFORMERS BUILT TO MINISTRY SPEC.
Pri. tapped 105, 115, 125, 210, 230, 250 v Sec. 27 volts, 60 amps. Hermetically sealed in metal case. Size 11½ x 10 x 8in. Top mounted terminals. Manufactured by famous makers and supplied brand new in original wooden packing cases. **£12/10/-.** Carr. extra.
Also available: limited number only. Pri 190 210. 230, 250 v. Sec., 50 volts, 50 amps. Size 10 x 9 x 8in. **£15.** Carr. extra.

FOSTER DOUBLE WOUND STEP DOWN TRANSFORMERS
Pri. 220-240 v. Sec. 110 v. 2 kVA. Shrouded. Guaranteed in perfect condition **£9/15/-.** Carr. 10/-.



LATEST TYPE REED RELAYS
Complete with Socket and Mounting Clips.
500Ω 12CO contacts size 2 x 2 x 2in. 12/6
900+500Ω 6CO contacts size 2 x 1⅜ x 1in..... 10/6
1,500 + 500Ω 4CO contacts size 2½ x 2 x ½in. 8/6
700+400Ω 4 CO contacts size 2½ x 2 x ½in..... 8/6
650+650Ω 4 CO contacts size 2½ x 2 x ½in..... 8/6
700+4CO contacts size 1⅜ x 1⅜ x ½in..... 8/6
Measurements given include socket. Special prices for quantities. Samples sent on request.

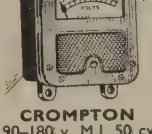


LATEST TYPE SIEMENS MINIATURE RELAYS
In transparent capsules. Gold plated springs and contacts. Six makes. 3 types. 2,500Ω, 6,500Ω, 9,000Ω. Size 1⅜ x ⅜ x 1⅛in. Weight ⅜ oz. Unrepeatable. At under half manufacturer's price. **12/6** ea. **£6/10/-** doz.

L.T. SUPPLY UNIT TYPE S.E.1

A.C. input 200-240 v. D.C. Output tapped to give 12 or 24 volts 8 amps. continuous rating. Fitted with panel fuse. Mains on/off switch and D.C. output socket. Built in strong metal case. Size 15 x 6 x 6in. An ideal general purpose L.T. supply unit for operating relays. Contactors, battery charging, etc. **£9/19/6,** carr. 7/6.

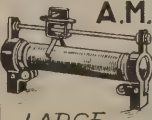
JUST ARRIVED! SPECIAL PURCHASE OF OVER 2,000 BRAND NEW POWER TRANSFORMERS. Manufactured by famous makers. Latest type. "C" Core, hermetically sealed in oil-filled metal cases, upright or inverted mounting. Offered at a fraction of maker's price. At present we are unable to list these transformers. Let us know your requirements or better still call and see us.



HIGH GRADE M.C. D.C. VOLTMETERS
180–280 volts 5½ x 2in. Rectangular dial. Set in wall mounting case, size 8 x 6½ x 3½in. with lamp fitting to illuminate dial. Supplied brand new at a fraction of maker's price, **37/6,** p.p. 3/6.

CROMPTON PARKINSON A.C. VOLTMETERS.
90–180 v. M.I. 50 cycles. 4½in. scale. Flange mounting. Supplied new and guaranteed at a fraction of maker's price. **27/6.** P.P. 4/-.

SPECIAL OFFER—E.A.C. LTD. A.C. 0-300 VOLTMETERS.
6 inch flush mounting, iron case protected, panel hole 6⅜in. Supplied brand new in sealed cartons at a fraction of maker's price. **£3/15/-.** Carr. 4/-



4Ω 8 Amps. SINGLE TUBE SLIDER ENCLOSED, **30/-**, P.P. 4/-. 100Ω 1 Amp. SINGLE TUBE SLIDER ENCLOSED, **25/-**, P.P. 3/-. 25Ω 4 Amps. SINGLE TUBE SLIDER, **22/6**, P.P. 3/-. SINGLE TUBE ROTARY SWEEP SLIDER TYPES, 0.75Ω 12 Amps., **17/6**. 1.2Ω 10 Amps. **17/6**, P.P. 3/-. 1Ω 12 Amps. SINGLE TUBE SLIDER, **12/6**, P.P. 2/6. 12,000Ω 0.003 Amp. DOUBLE TUBE GEAR DRIVE, **29/6**, P.P. 4/6. 520Ω 2.3/0.45 Amp. SINGLE TUBE FIXED RESISTORS, **10/6**, P.P. 3/-. 26Ω 4 Amps. 6IN. DIA. RHEOSTATS, **45/-**. Carr. 4/-.

SPECIAL OFFER OF L.F. CHOKES
Manufactured by famous makers. Supplied brand new and guaranteed. 10H. 250 m/A. 124Ω open construction, **15/-**. P.P 4/-. 15H, 250 m/A., 125Ω. Sealed. Oilfilled. "C" core, **22/6**. P.P. 5/-. 10H. 120 m/A.. 250Ω sealed. O.F. "C" core. **10/6**. P.P. 3/-. 0.1H., 1 amp.. 2Ω. open construction, **10/6**. P.P. 2/6. 10H, 75 mA., 200Ω open construction. 10H., 500 mA., 40Ω, open construction, **30/-**. Carr. 5/-. Also available low resistance smoothing. Let us know your requirements.

HIGH VOLTAGE CAPACITORS 1 MFD. 20,000 V. WKG. Tropically rated. Size H. 11in. plus insulated terminals. Sin. W. 13in., D. 4in. Supplied brand new in maker's packing case at a fraction of original price. **£7/10/-.** Carr. 7/6.
OTHER TYPES AVAILABLE
T.C.C. 1 mfd. 7,500 v. wkg. at 70°C., **50/-**. Carr. 7/6. 0.5 mfd., 15,000 v. wkg. at 60°C., **79/6**. Carr. 7/6. 0.001 mfd., 15,000 v. wkg. **45/-**. Carr. 5/- 1.5 mfd., 4,000 wkg., **12/6**. P.P. 2/6. 1 mfd., 2,500 v. wkg. at 60°C., **15/-**. P.P. 2/-. 0.5 mfd., 7,500 v. wkg. at 71°C., **25/-**. P.P. 2/6. 4 mfd., 1,500 v. wkg. at 71°C., **10/6**. P.P. 2/-. 4 mfd., 1,000 v. wkg. at 60°C. **7/6**. P.P. 2/-. 10 mfd., 450 v. wkg. at 140°F., **8/6**. P.P 2/-. 8 mfd., 600 v. wkg., at 71°C. P.P. 7/6. 2 mfd., 200 v. wkg. at 71°C., **2/6**. P.P. 1/6. 1 mfd., 500v. wkg. at 60°C., **2/-**. P.P. 1/-.
DUBILIER. 4 mfd., 3,000 v. wkg. at 71°C., **25/-**. P.P. 3/-. 2 mfd., 2,500 v. wkg. at 71°C., **17/6**. P.P 2/6. 1 mfd., 5,000 v. wkg. at 71°C., **25/-**. P.P. 3/-. 0.5 mfd., 5,000 v. wkg. at 71°C., **15/-**. P.P. 3/-. 0.25 mfd., 7,500 v. wkg. at 71°C., **17/6**. P.P. 3/-. 0.25 mfd., 5,000 v. wkg. at 71°C., **12/6**. P.P. 2/6. 0.1 mfd., 5,000 v. wkg., **10/6**. P.P. 2/6. 8 mfd., 900 v. wkg. at 71°C., **8/6**. P.P. 2/-. 0.5 mfd., 10,000, **37/6**. Carr. 3/6.
AMERICAN. All tropically rated. 10 mfd., 300 v. wkg., **5/6**. P.P. 2/-. 8 mfd., 50 v. wkg., **7/6**. P.P. 2/-. 3 mfd., 1,000 v. wkg., **7/6**. P.P. 2/-. 0.15+0.15 mfd., 8,000 v. wkg., **10/6**. P.P. 1/6. 0.1 mfd., 7,000 v. wkg., **8/6**. P.P. 1/6. 0.2 mfd., 5,000 v. wkg., **7/6**. P.P. 1/6. 8 mfd., 1,500 v. wkg., **17/6**. P.P. 2/6. 10 mfd., 600 v. wkg., **8/6**. P.P. 2/-. 2 mfd., 5,000 v. wkg., **£3**. Carr. 4/-.
I.B.M. D.C. SUPPLY UNITS. Designed to give 75 volts 2½ amps. D.C. output from A.C. 200–250 volts. **65/-**. Carr. 5/-
PLANNAIR AXIAL BLOWERS A.C. 230 volts dia. 3⅜in. Tube length 3½in. ½in. flange each end. New condition. **49/6.** P.P. 3/6.

BRAND NEW VARIAC TRANSFORMERS
Input 110 v. Output 0-110 v. 7 amps. Panel mounting. Supplied brand new with control knob and fixing bolts, in maker's original packing cases **£4/17/6.** Carr. 5/-

VENNER ELECTRIC TIME SWITCHES, 200-250 v. A.C. 15 amp. contacts, once on, once off every 24 hours. Any manually preset times. Manual on/off shorting switch, complete with mounting block. Perfect condition. **69/6.** P.P. 3/6.

ROLLER TYPE MICRO SWITCHES
Normally closed, **54/-** doz. Normally open, **54/-** doz. Universal, **60/-** doz.

A.C. 200-240 v. CHECK METERS. 25 amps. L.R., **32/6**. P.P. 3/-. 10 amp. L.R., **22/6**. P.P. 3/-. 5 amp. L.R. **17/6.** P.P. 2/6.
Guaranteed in perfect condition.

SPECIAL OFFER BRAND NEW A.M. LEAD ACID ACCMULATORS. 2 v. 14 A.H. Size 6¾in. high, 2in. sq. Ideal for constructing 6 or 12 v. batteries. **4/11** each. P.P. 2/-. Six for **27/-**. Carr 5/-. Supplied with charging instructions.
EQUIPMENT WIRE 14/36 P.V.C. 100 yd. coils, 9 different colours. **65/-**, carr. 4/-. Ten coils, carr. 5/-. Single coils, **7/6**, carr. 1/6.

4WW—146 FOR FURTHER DETAILS.

THAT "DIFFICULT" COMPONENT

..... order it on

No matter how new or how old the set you are servicing, if you require a line output transformer it is 999-1 that we will have it in stock or can rewind it quickly.

We operate a same day despatch service from the largest stocks of television components in the U.K., including a comprehensive range of accessories, materials and test gear of all kinds.

TERMS: C.W.O. OR C.O.D.

Retail quotations gladly given on receipt of s.a.e.
Trade—Please send your letter headings for data charts

SAME DAY SERVICE ... from DIRECT T.V. REPLACEMENTS LTD.

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'Phone: GIP 6166, (PBX) Day & Night Ansafone Service

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THE NEW Richard Allan C.G. 12 NEEDS ONLY A SMALL SPACE.....

Incorporates the latest in ceramic magnet design. Only 4½" deep 25-5,000, c.p.s. (25-15,000 c.p.s. with Tweeter Inner). Output 10 watts. Individually hand made.

Full details from:—
RICHARD ALLAN RADIO LTD.,
Taylor Street, Batley, Yorkshire.
Telephone BATLEY 1123, 1308.

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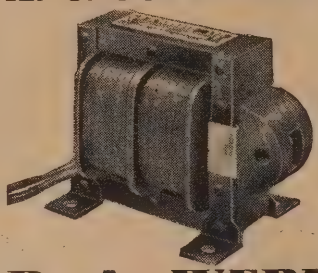
A. C. SOLENOID TYPE SBM



Now fitted with stainless steel guides— six times the life
Continuous 3¾ lbs. at 1"
Instantaneous to 16 lbs.
Smaller sizes available
Also—Transformers to 7kVA 3 phase.

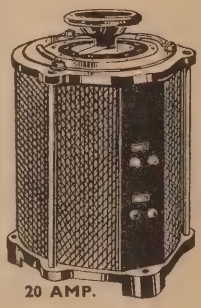
R. A. WEBBER LTD.

KNAPPS LANE, CLAY HILL, BRISTOL 5 PHONE 65-7228/9

4WW—149 FOR FURTHER DETAILS.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230 v. AC 50/60 ~



20 AMP.

BRAND NEW. Carriage Paid. Buy direct from the importer, keenest prices in the country. All Types and Spares available from stock.

We are pleased to announce further additions to our range:

Type 1	0-260 v. at 1 amp ...	£4 10 0
Type 2	0-260 v. at 2.5 amps	£5 17 6
Type 3	0-260 v. at 5 amps ...	£9 0 0
Type 4	0-260 v. at 8 amps ...	£14 10 0
Type 5	0-260 v. at 10 amps...	£16 10 0
Type 6	0-260 v. at 12 amps	£18 15 0
Type 7	0-260 v. at 20 amps...	£32 10 0

These instruments are fully shrouded

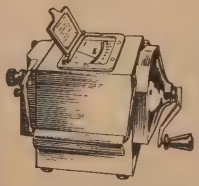
2.5 AMP.

PORTABLE

Input 230 v. A.C. Output variable 0-260v. A.C. at 2.5a.

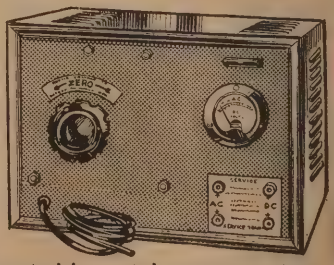
Fitted in beautifully finished steel case. Complete with volt meter, pilot lamp, fuse, switch, carrying handle, **£9/17/6.**

INSULATION TESTERS (NEW)



Test to I.E.E. Spec. Rugged metal constructed, suitable for bench or field work, constant speed clutch. Size L. 8in., W. 4in., H. 6in. Weight 6lb. 500 volt, 500 megohms. Price **£22**, carriage paid. 1,000 volts, 1,000 megohms, **£28**, carriage paid.

7 Ampere A.C./D.C. VARIABLE OUTPUT UNIT



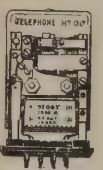
Input 230 v. A.C. Output continuously VARIABLE from 0 to 260 volts A.C. OR 0 to 230 volts D.C. at 7 amps. Robustly constructed in metal case, complete with safety fuse, neon indicator and voltmeter. Size 17in. x 12in. x 7in. Weight 36lb. Price £34/10/-. Carriage 20/-.

SERVICE TRADING COMPANY →

4WW—150 FOR FURTHER DETAILS.

ULTRA VIOLET BULBS

Easy to use source of UV for dozens of practical and experimental uses.
12 volt 36 watt AC/DC SBC **6/6.** P. & P. 1/–.
12 volt 60 watt AC/DC SBC **8/6.** P. & P. 1/-.
Transformer to suit the above: Input 200–240 A.C. 12 volt 36 watt, **16/6**; P. & P. 2/6. Input 200–240 A.C. 12 volt 60 watt, **22/6.** P. & P. 3/6.
Set of 4 Colours FLUORESCENT PAINT. Red-yellow, green and blue. In ½oz. tins. Ideal for use with the above Ultra Violet Bulbs. **9/6,** plus 1/6 P. & P.



CARPENTER'S TYPE 5C9B POLARISED RELAYS. 2 x 9,500 turns at 1,685 ohms. Price **22/6** each. P. & P. 1/-.

Type 5A57 (Z)A 65 ohms coil. Will operate on less than .5 of a volt. **22/6.** P. & P. 1/-.

NSP2 CV2296 STROBOTRON FLASH TUBE made by Ferranti, brand new. I.O. base. Price **15/-.** P. & P. 1/-.

FOSTER CONSTANT VOLTAGE TRANSFORMER

Automatic or hand operated. Input 250 volt +5 −15%. Output adjustable 200/250 volt. Max. load **80 AMP.** electro magnet control unit as new **£95** ex warehouse.

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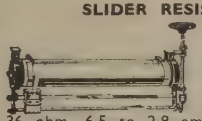

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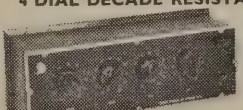

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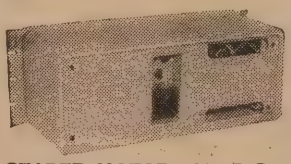

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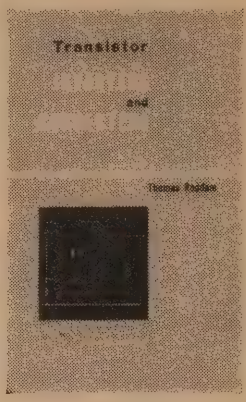

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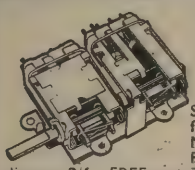

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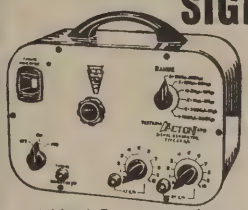

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50 MICRO-AMP METER movement by world-famous manufacturer. Size 3in. x 2¾in. **25/-** + 1/-.

PRESS-BUTTON COIL PACK. Medium and 2 shorts. Complete with twin-gang tuning condenser and ferrite rod aerial. **19/6**, plus 2/6 P. & P. Circuit diagram 2/6. FREE with pack.

SPECIAL OFFER!

OBTAINABLE ONLY FROM R. & T.V.

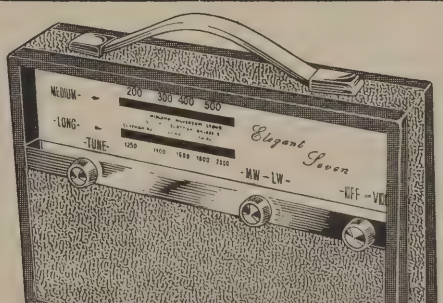
THE *"Elegant Seven"*

COMBINED PORTABLE & CAR RADIO

THE RADIO WITH THE "STAR" FEATURES

- ★ **7-transistor superhet. Output 350 mW.**
- ★ **Two-tone grey wooden cabinet, fitted handle with silver-coloured fittings. Size 12½in. × 8½in. × 3½in.**
- ★ **Horizontal tuning scale, size 11¼in. × 2⅜in. in silver with black lettering.**
- ★ **All stations clearly marked.**
- ★ **Ferrite-rod internal aerial.**
- ★ **IF 470 kc/s.**
- ★ **Operated from PP9 battery.**
- ★ **Fully comprehensive instructions and point-to-point wiring diagram.**
- ★ **Printed circuit board, back-printed with all component values.**
- ★ **Fully tunable over medium and long waveband.**
- ★ **Car-aerial socket.**
- ★ **Full after-sale service.**

Parts list and circuit diagram **2/6**. FREE with parts. 4½" speaker also available **7/6** extra.



ONLY £5.9.6

PLUS 5/6 POSTAGE AND PACKING

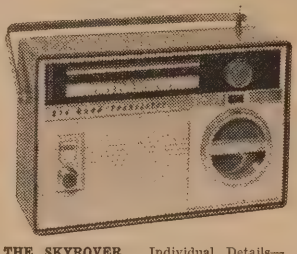
RADIO AND T.V. COMPONENTS (ACTON) LTD.

21A, ACTON HIGH ST., LONDON, W.3. ● *Goods not despatched outside U.K. All enquiries S.A.E. Terms C.W.O.*

SHOP HOURS 9 a.m.—6 p.m. EARLY CLOSING WEDNESDAY

HOME CONSTRUCTORS LOOK—

AT THIS OUTSTANDING RANGE OF TRANSISTORISED RADIOS!!



THE SKYROVER. Individual Details—controls: Waveband Selector, Volume Control with on/off switch. Tuning Control with easy to read Dial Scale. In attractive plastic cabinet, size 10×6½×3½in., with metal trim and carrying handle.

MAY BE BUILT FOR All parts sold separately. **£10.19.6**

THE SKYROVER | THE SKYROVER De Luxe

GENERAL SPECIFICATION FOR BOTH MODELS

7-transistor and 2 diode superhet—6 waveband portable receiver, covering the full Medium Waveband (180-576 M) and Short Waveband (32-94 M) and in addition 4 separate switched Band Spread Ranges on 13M, 16M, 19M, and 25M/bands—with manual Band Spread Tuning for accurate Station selection. I.F. frequency 470 Kc/s. Output 500 MW. 5in. Ceramic Magnet P.M. Speaker. Telescopic and internal Ferrite Rod Aerial. All Mullard Transistors and Diodes. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our detailed and easy to follow instructions. Operates on four 1.5v. torch batts. (U2 or equivalent).*

Circuit diagram and data for each set 2/6 extra, free if all parts bought. Four U2 batteries 2/8 extra. Four Leak-Proof Batteries, 3/4 extra.

Add 5/- P. & P. on each parcel.

THE SKYROVER DE LUXE

Tone Control Circuit is incorporated with separate Tone Control in addition to Volume and Tuning Controls and Waveband Selector. In sturdy wood cabinet, size: 11½×6½×3in. covered in washable material with plastic trim and carrying handle. Also Car Aerial socket.

MAY BE BUILT FOR All parts sold separately. **£12.19.6**

READY BUILT BARGAINS

2-TRANSISTOR POCKET RADIO FULLY BUILT PLUS ALL EXTRAS

Ready made as illustrated—complete with personal earpiece, telescopic aerial, battery and carrying case! Wonderful value and performance—full medium waveband coverage—built in 2½in. speaker gives full tone reproduction. Works on single PP3 9 v. battery. In attractive plastic case—size only 4×2½×1in. All accessories included in the price.

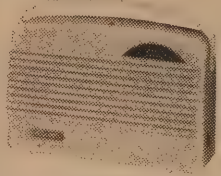
WIRECOMP'S PRICE COMPLETE **42/-** POST FREE

ALSO 6 TRANSISTOR POCKET RADIO—FULLY BUILT

Wonderful performance. Tunable over full medium waveband. Built in 2½in. speaker. In attractive plastic carrying case—size 4 × 2½ × 1in. Operates on single PP3 9 v. battery. Supplied complete with personal earpiece, leather carrying case and battery.

WIRECOMP'S PRICE COMPLETE **79/6** P. & P. 2/6.

THE 'REALISTIC 7'



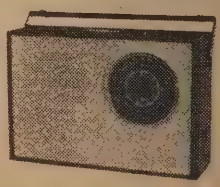
A fully transistorised Portable Receiver made to the highest professional standards—is now available to the home constructor. Comprises 7 Mullard Trans, OC44, OC45's, OC71, OC81D, and 2 OC81's plus OA70 Crystal Diode. Delivers 350 milliwatt output to 4in. high flux speaker—I.F. frequency 470 Kc/s—fully tunable over medium and long wavebands. All components mounted on single printed circuit board, size 5½ × 5½in. Attractive two-tone plastic cabinet with carrying handle—size 7×10 × 3½in. with easy to read dial and socket for car aerial, choice of Red/Grey, Blue/Grey or all Grey. Complete with full instructions.

All parts sold separately

MAY BE BUILT FOR **£5.19.6** Battery 3/9 extra.

P. & P. 4/6 extra. (Circuit diagram 2/6 free if all parts bought.)

AND NOW BY REQUEST THE 'REALISTIC 7 De Luxe'



A "De-Luxe" version of the well-proven "Realistic 7" is now available, with the same specification as the standard model PLUS a restyled superior wood cabinet covered in attractive washable material with chrome trim and carrying handle. AND ALSO a full vision circular tuning dial (externally mounted) to further improve this wonderful set.

Only £1.0.0 extra

P. & P. etc. as Standard Model

THE 'SPRITE'

A six transistor superhet Miniature Pocket Radio of Commercial Quality. Fully tunable over Long and Medium wavebands. Uses printed circuit and high sensitivity internal ferrite rod aerial. I.F. frequency 470 Kc/s. Transistors: 3-Philco 2067s, 2-Mullard OC81M, OC81DM and OA90 diode, 3 inch speaker. Works on single PP3 battery. Supplied with the complete RF and IF stages, driver and output stages, ready built and mounted on the printed circuit: for final assembly you have only to fit the wave-change switch, tuning condenser and drive, volume control, earphone socket and aerial rod. In very attractive plastic case, size 4×2½×1in.

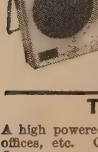
MAY BE BUILT FOR **79/6** All parts sold separately.

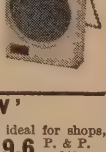
Real Calf Leather Case, wrist strap and Personal Earphone with case, and battery **12/6** extra.

P. & P. 3/6 extra. (Data and instructions 2/6, free if all parts bought.)

TRANSISTOR INTERCOMS

BABY ALARM/INTERCOM





In 2 compact units, each size 4in.×2½in. ×1in. Internal loudspeakers give ample volume. Complete ready for immediate use. Works from PP3 battery. Complete with battery and sixty feet of connecting wire.

69/6 P. & P. 2/6.

THE 'RAINBOW'

A high powered 2 station Intercom, ideal for shops, offices, etc. Complete with flex. **£6.19.6** P. & P. 3/6.

E.M.I. 4-SPEED RECORD PLAYER

New, unused and individually boxed, fitted with lightweight pick-up with ACOS G.P. 73/2 stereo cartridge. Cabinet space required 13½×12½×4½ inches. A 9-inch metal turntable is fitted. For use on 200/250 volt A.C. mains, with Auto-stop. The stereo cartridge will play all types of Mono Records, 78's, L.P.'s etc., but if desired, a G.P. 67 L.P./78 Mono cartridge will be supplied in lieu of the G.P.73 at no difference in cost.

P. & P. 3/6. Price **79/6**

AMPLIFIERS

8 WATT MONO AMPLIFIER

£5.5.0

Made by well-known manufacturer. Spec. 2 - EL84, 1-EZ80 and 1-ECC83 Push-Pull output. Separate Bass and Treble controls on panel with extended lead. **P. & P. 3/6.**

AND NOW the above amplifier with its well-proven specification is available to you as a 2×4 watt STEREO AMPLIFIER. Two output transformers and two speaker outputs—for little extra cost!

ONLY £6.19.6 P. & P. 5/- extra.

COLLARO TRANSCRIPTION DECK

COLLARO 4TR 200 Transcription Record Player Unit. New and unused—listed at 17 gns.

Carriage & Packing 5/- **£9.19.6**

CRYSTAL PICK-UP CARTRIDGES

All Complete with Styli. Add 1/- P. & P.

MONO Type C.T.1. By well-known manfr. With 2 sapphire styli	9 6
Garrard Ceramic G.C.E.4	15 0
Garrard Magnetic T.O.M.2	15 0
Acos G.P.59	14 0
Acos. G.P.65/3	15 0
Acos G.P.65/1	17 0
Acos G.P.67/1	14 0
STEREO Acostereo 73/1, with 2 sapphires	25 0
Acostereo 73/2, with Diamond LP/Stereo and sapphire Std.	29 6
Collaro type C Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with Diamond L.P./Stereo and sapphire Std.	25 0
Ronette Stereo O.V. Turnover, with 2 sapphires	25 0
Ronette Stereo types 105 and 106 with 2 sapphires	35 6
Ronette Stereo types 105 and 106 with Diamond L.P./Stereo and sapphire Std.	39 6

STOCK ITEMS

B.S.R. UA14 4 speed auto.	£5 19 6
GARRARD Auto-Slim Mono	£6 10 0
GARRARD Auto-Slim Mono plug-in-head	£7 7 0
GARRARD Auto-slim De Luxe Mono	£11 9 0
GARRARD Auto-Slim De Luxe Stereo	£12 5 0
GARRARD T.A. Mk. II single play Mono	£7 17 6

Add 5/- P. & P. on all above.

THE PETIT FULMITER

A.C. ELIMINATOR AND 9v. BATTERY CHARGER **18/6** P. & P. 1/6

Converts your Miniature Transistor Set to Mains for the winter. For use with all 9 v. transistor receivers (approx. same size as PP3 battery).

TAPE

FULLY GUARANTEED, AT RECORD LOW PRICES

Famous make, P.V.C. base on latest type plastic spools. New, perfect, boxed, guaranteed.

1,200ft. on 7in. spool	15 0
1,800ft. on 7in. spool	19 6
1,200ft. on 5½in. spool	17 6
850ft. on 5½in. spool	11 6
600ft. on 5in. spool	11 3
225ft. on 3in. spool	4 11
2,400ft. D.P. on 7in. spool	32 6

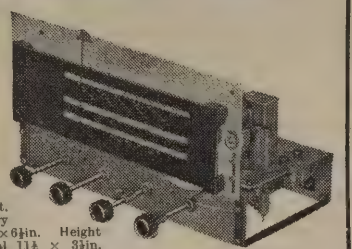
WIRECOMP ELECTRONICS

378 HARROW ROAD, LONDON, W.9. TEL.: CUNNINGHAM 9530

Hours of Business: 9 a.m. to 6 p.m. Open all day Saturday. Opposite Paddington General Hospital. Buses 18 8B and 36 pass the door.

4WW—156 FOR FURTHER DETAILS.

7 VALVE AM/FM RADIOGRAM CHASSIS



Valve line-up ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.

Three Waveband and Switched Gram positions. Med. 200-550 m. Long 1,000-2,000 m. VHF/FM 88-96 Mc/s. Philips Continental Tuning insert with permeability tuning on FM and combined AM/FM IF transformers. 460 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ × 6½in. Height 7¼in. Edge illuminated glass dial 11¼ × 3½in. Vertical pointer Horizontal station names. Gold on brown background. A.C. 200/250 v. operation. Magic-eye tuning. Cct. diag. now available.

Aligned and tested ready for use. **£13 . 10 . 0** *Carr. & Ins. 5/-*

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial 3/6 extra. 3 ohm P.M. Speaker only required. Recommended Quality Speakers 10in. Elac H/D, 30/-. 13½in. × 8in. E.M.I. Fidelity, 35/-. 12in. R.A. with cone Tweeter, 42/6. Carr. 2/6.

CO-AX 80 ohm CABLE

High grade low loss Cellular Air Spaced Polythene—¼in. diam. Stranded Cond.

Now only 6d. yard.

BARGAIN PRICES—SPECIAL LENGTHS
20 yds. 9/-; P. & P. 1/6. Coax. Plugs 1/-.
40 yds. 17/6. P. & P. 2/-. Sockets 1/-.
60 yds. 25/-. P. & P. 3/-. Couplers 1/3.

VALVES

NEW BOXED		ALL GUARANTEED			
1T4	3/6	ECL82	10/-	PCF80	8/-
1R5, 185	6/-	ECL80	9/-	PCL83	10/6
384, 3V4	7/-	EF80	7/6	PCL84	9/-
DAF96	8/-	EF86	8/6	PL81	9/6
DF96		EL84	7/-	PL82	9/-
DK96		EY51	9/-	PL83	8/-
DL96		EY86	9/-	PY32	10/6
EC81	7/-	EZ81	7/-	PY81	8/-
EC82		GZ32	9/6	PY82	7/-
EC83		PCC84	8/-	U25	10/6

TRIMMERS. Ceramic (Compression Type)—30 pF., 50 pF., 70 pF., 9d.; 100 pF., 150 pF., 1/3; 250 pF., 1/6; 600 pF. 1/9.

PHILIPS, Bee Hive Type (conc. air spaced)—2-8 pF. 1/-; 3-30 pF. 1/-.

METAL RECTIFIERS-STC Types—RM1 4/9; RM2 5/6; RM3 7/6; RM4 16/-; RM5 21/-; RM4B 17/6.

JACK PLUGS—2¼in. Igranic type 2/6; Screened ditto 3/8; 1¼in. Screened 2/3; Transistor type Min. & Sub-min. 1/3.

JACK SOCKETS—Moulded Igranic type, open 3/6, ditto closed 4/-. Pax. type open 2/6, ditto closed 3/-. Transistor type closed, Min. & Sub.-min. 1/6.

EAR PLUG PHONES—Min. Continental type 3ft. lead, jack plug and socket. High Imp. 8/-. Low Imp. 7/6.

WAVECHANGE SWITCHES. 1 p. 12-way, 2 p. 2-way, 2 p. 6-way, 3 p. 4-way, 4 p. 2-way, 4 p. 3-way, long spindle, 3/6 ea.

STYLUS REPLACEMENTS. Diamond Styli for L.P.. or Stereo, for all pop. types, B8R, Collaro, Garrard, etc., 11/8 ea. Gtd. 12 mths. SAPPHIRE ditto, 5/3 ea. Comp. range in stock.

TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s ⅝in. diam. 5/6
Osc. Coil M/W ⅝in. dia.... 5/3
Osc. Coil M. & L.W. 5/9
Midget Driver Trans. 3.5 : 1 6/9
Midget Output Trans. Push-Pull—3 ohms 6/9
Elec. Condensers—Midget Type 1 mfd.-50 mfd. ea. 1/9, 100 mfd. 2/-. 12 v. wkg.
Condensers 150 v. working: .01 mfd., .02 mfd., .03 mfd., .04 mfd. 9d.; .05 mfd., .1 mfd., 1/-, .25 mfd. 1/3; .5 mfd. 1/6, etc.
Midget Tuning Condensers J.B. "OO" 208 pf. and 176 pf. 8/6; ditto with trimmers 9/6. JB 220pf. and 105 pf. conc. slow motion 10/6. 365 pf. single 7/6. Sub Min. ¾in. Dilemin 100 pf., 300 pf., 500 pf. 7/- each
FERRITE AERIALS. M & L.W., car aerial coil 9/3.
Midget Vol. Control with edge control knob. 5 K/ohms, with switch, 4/9. Ditto less switch 3/9.
Speakers: P.M.: 2in. Plessey 75 ohms 15/6. 2½in. Continental 8 ohms 13/6. 7 × 4in. Plessey 35 ohms 23/6. 2½in. Continental 8 ohms 13/6.

TRANSISTOR BARGAINS

Brand New—BVA 1st Grade

OC44	8/6	OC70	5/6
OC45	8/-	OC71	6/-
OC81	7/6	GEX34	2/9
GET114	6/6	OA70	2/9
OC72	7/6	OA81	2/9
AF117	9/6	OA79	2/9

BARGAIN CORNER

Brand New. Mfrs. surplus 1st grade 1 OC44 & 2 OC45, 15/6. 1 OC81D & 20C81, 15/6. All above and OA81, 32/6 post free.
¼ Meg. VOL Controls D.P. Sw. ¼in. flatted spindle. Famous Mfrs. 4 for 10/- post free.

BARGAINS 4-SPEED PLAYER UNITS

Single Players	carr. 3/6
E.M.I. Stereo/Mono. ...	£5 10 0
B.S.R. Latest Mod. TU12	£3 12 6
E.M.I. Junior "985"...	£3 7 6
Auto-Changers	carr. 5/-
Garrard "Auto-Slim"	£6 19 6
B.S.R. (UA 16).....	£6 19 6
B.S.R. (UA14)	£6 10 0

MULLARD "3–3" HI-FI AMPLIFIER. 3 VALVES 3 WATT

3 ohm and 15 ohm Output. A really first-class Amplifier giving Hi-Fi quality at a reasonable cost. Mullard's latest circuit. Valve line up: EF86. EL84, EZ81. Extra HT and LT available for Tuner Unit addition. This is the ideal companion Amplifier for FM tuner units.

TECHNICAL SPECIFICATION—Freq. Response: + or — 1 db. 40 c/s-25 Kc/s. Tone controls: Max. Treble Cit 12 db. at 10 Kc/s. Max. Bass Boost 14 db. at 80 c/s. Sensitivity: 100 Mv for 3 w. output. Output Power (at 400 c/s); 3 w. at 1% total harmonic distortion. Hum and Noise Level: At least 70 db. below 3 w.

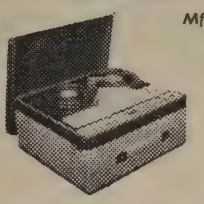
COMPLETE KIT (incl. valves, all components wiring diagram and special quality sectional Output Trans.). **BGN. PRICE £6/19/6.** Carr. 4/6.

Complete wired and tested, 8 gns. Wired power O/P socket and additional smoothing for Tuner Unit. 10/6 extra.

Bronze Escutcheon Panel, Printed Vol. Treble, Bass, On-Off, supplied with each Kit.

Recommended Speakers—WB, HF 1012 87/6. Goodmans AXIOM 10 £6/5/-. 8in. AXIETTE £5/5/-, or AUI 10M 51, £8/10/-.

ANOTHER TAPE RECORDER BARGAIN



Mfrs.' end of production Surplus Offer

A 24 gns. Tape Recorder offered at the bargain price of only 15 gns, plus 10/- carr. Supplied in 3 Units already wired and tested. A modern Circuit for quality recording from Mike Gram or Radio, using latest B.S.R. Twin Track Monarch deck Type TD2.
Valve line-up—EF86, ECL82, EM84, EZ80 and Silicon Diode. Send for detailed list—3d. stamp.

Complete Kit comprising items below.

BARGAIN PRICE 15 Gns. +10/- Carr.

2-tone Cabinet and 8in. × 5in. Speaker. Size 14in. × 10½in. × 7½in.	£3	10	0	+ 5/- Carr.
Wired Amplifier complete with 4 Valves, front Panel, Knobs, etc.	£5	12	6	+ 3/6 Carr.
B.S.R. Monarch Deck Type TD2	£7	7	0	+ 4/6 Carr.
Accessories: Mike, Tape, empty Reel, screened Lead and Plugs, Instructions, etc.	£1	0	0	+ 2/- Carr.

We manufacture all types Radio Mains, Transf. chokes, Quality O/P Trans., etc. Enquiries invited for specials, prototypes for small production runs. Quotation by return.

RECORDING TAPE

Famous American Columbia (CBS) Premier quality tape at NEW REDUCED PRICES. A genuine recommended Quality Tape—TRY IT! Brand new, boxed and fully guaranteed. Fitted with leader and stop foils.

Standard		Double Play	
5in. 600ft. ..	13/-	1,200ft...	31/6
5¼in. 900ft. ..	16/-	1,800ft...	37/6
7in. 1,200ft ..	21/-	2,400ft...	47/6
Long Play		Post & Pack.	
5in. 900ft. ..	17/6	per reel, 1/- plus	
5¼in. 1,200ft.	19/6	6d. ea. for additional reels.	
7in. 1,800ft...	28/6		

SPECIAL OFFER. 3in. Message tape, 150ft. 3/9; 3in. L.P. 225ft. 4/9; 3in. D.P. 300ft. 6/6; P. & P. per reel 6d.
TAPE REELS. Manfrs. surplus 7in. 2/3; 5¼in. 2/-; 5in. 2/-; 3in. 1/3; Plastic spool containers. 5in. 1/9; ¼in. 2/-; 7in. 2/3.

SPEAKERS P.M. 3 ohms. 2½in. EM1. 15/6. 3in. Goodmans 16/6. 5in. Rola 15/6. 6in. Elac 16/6. 7in. × 4in. Goodmans, 15/6. 8in. Rola 19/6. 10in. Elac 25/-. 10in. × 6in. Goodmans 22/6. 2½in. E.M.I. Tweeter. 22/6. 13½in. × 8in. E.M.I. 35/-.

ENAMELLED COPPER WIRE—¼lb. reels 14g-20g. 2/6; 22g-28g. 3/-; 30g-34g. 3/9; 30g-38g. 4/3; 39g-40g. 4/6, etc.

TINNED COPPER WIRE 16-22g., 2/6 ¼lb.

VALVE HOLDERS—Int. Oct. 6d. Nylon or Ceramic, B7G. B9A unskirted, 9d. B7G B9A skirted, 1/- each; B7G with Can 1/6: B9A with Can, 1/9 etc.

KNOBS—Modern Continental types: Brown or Ivory with Gold Ring. 1in. dia. 9d. each, 1¼in. 1/- each, Brown or Ivory with Gold Centre 1in. dia., 10d. each; 1¼in. 1/3 each.
LARGE SELECTION AVAILABLE.

TYGAN FRET (Contem. pat.). 12 × 12in. 2/-; 12 × 18in. 3/-; 12 × 24in. 4/-, etc.
BONDACOUST Speaker Cabinet Acoustic Wadding, 12in. wide, any length cut 1/6 ft. 4/- yd. **EXPANDED ANODIZED METAL** Attractive gilt finish ¼in. × ¼in. diamond mesh 4/6 sq. ft. Multiples of 6in. cut. Max. size 4ft. × 3ft. 47/6 plus carr.

JASON F.M. TUNER UNITS
Designer-approved kits available.
FMT1 5 gns., 4 valves, 20/-.
FMT2, £7. 5 valves 35/-.
JTV Mercury, 10 gns. 3 valves 22/6
JTV2. £13/19/6. 4 valves 28/6
NEW JASON F.M. HANDBOOK, 2/6
48 hr. Alignment Services, 7/6 plus 2/6

CONDENSERS—Silver Mica. All values 2 pf. to 1,000 pf., 6d. each. Ditto ceramics 9d. Tub. 450 v. T.C.C., etc. .001 mfd., .01 and .1/350 v. 9d. .02-1/500 v., 1/-. .25 Hunts 1/6. .5 T.C.C. 1/9, etc., etc.
CLOSE TOL. S/MICAS. 10% 5 pf.-500 pf. 9d. 600-5,000 pf. 1/- 1% 2 pf.-100 pf. 9d. 100 pf.-500 pf. 11d. 575 pf.-5,000 pf. 1/6.

RESISTORS—Modern ratings full range 10 ohms to 10 megohms. 20% ⅛-½ w. 3d. ea., ditto 1 w. 6d. ea., 2 w. 9d. ea. 10% ⅛-½ w. 4d. ea. 5% Hi-stab, ⅛-½ w. 6d. ea. (below 100 ohms and over 1 meg. 9d. ea.). 1% Hi-stab, ⅛ w. 1/6 ea. (below 100 ohms 2/- ea.).
WIREWOUND. 25 ohms to 10K. 5 w. 1/3 10 w. 1/6, 15 w. 2/-.

PRE-SET T/V POTS. W/W 25 ohms-50 K. 3/-. 50 K-2 Meg. (Carbon). 3/-.

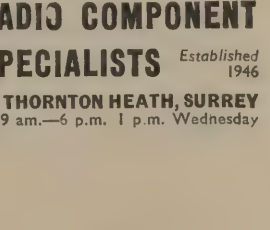
Electrolytics All Types New Stock

TUBULAR		CAN TYPES	
25/25v. 50/12v.	1/9	8+8/450 v.	4/6
50/50v.100/25v.	2/-	32+32/275 v.	4/6
8/450v. 4/350v.	2/3	50+50/350 v.	6/6
16/60/450 v.	5/6	60+250/275v.	17/6
32/32/450 v.	6/6	100+300/275v	12/6

Transistor Midge types—all values 1 mfd. to 50 mfd. 1/9 ea. 100 mfd. 2/-, 12 v.

VOLUME CONTROLS—5K—2 Megohms, 3in. SPINDLES, MORGANITE MIDGET TYPE. 1½in. dia. Guar. 1 year. LOG or LIN. ratios, less Sw., 3/- D.P. Sw. 4/6. Twin Stereo less Sw. 6/6. Some values with DP Sw. 8/6.

RECORD PLAYER CABINETS



Rexine covered cabinet in two-tone maroon and cream. Size 15¾" x 14¼" x 8½", with all accessories inc. baffle board and Vinair fret. Space for all modern amplifiers and auto-changers etc. Uncut record player mounting board 14" x 13" supplied.

Cabinet Price **59/6**

Carr. & Ins. 5/-.

2-VALVE 2-WATT AMPLIFIER

EZ80 and Twin stage ECL82 with vol. and neg. feedback tone control. A.C. 200/250 v. with knobs, etc., ready wired to fit above cabinet, complete with 7in. × 4in. Quality Speaker and O/P Trans., £3/19/6. Carr. 2/6. **Complete Record Player Kit as illustrated. inc. BSR UA 14 Unit. New reduced price: £11/10/-.** Carr. 7/6.

DE LUXE RECORD PLAYER KIT

now available, based on Mullard 3-watt circuit, with Bass Boost and Treble Control and 8 in. × 5 in. High Flux Speaker, with Garrard Auto Slim unit. Complete Kit **£13.19.6** Plus 10/- carr.

Only a few items are listed from our comprehensive stock. Write now for full bargain lists 3d.

Terms: C.W.O. or C.O.D., post and packing ½lb. 9d., 1lb. 1/3. 3lb. 2/3, 5lb. 2/9, 10lb. 3/9 etc.

TRS RADIO COMPONENT SPECIALISTS *Established 1946*

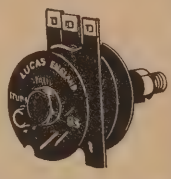
70 BRIGSTOCK RD., THORNTON HEATH, SURREY
Tel. THO 2188: Hours: 9 am.—6 p.m. 1 p.m. Wednesday

PROOPS Walk-around Store
and MAIL ORDER SERVICE

52 Tottenham Court Road, London, W.1. ● *Open 9-6, including Sats., Thurs. 9-1* ● **LANgham 0141**

30 VOLT POWER PACK £4.10.0

Carriage 5/-



For charging 24 volt battery systems and operating the hundreds of surplus items that require a 24-30 volts D.C. supply. **Specially manufactured transformer is suitable for mains inputs of 200/240 volts, output: 31 and 17 volts at 6 amps. Rectifier is latest diffused silicon bridge type, rated 5 amps. output at 50 p.i.v.** Dimensions: Transformer 4⅝ × 3⅜ × 4in. (universal mounting). Rectifier 1½in. diam. × 2in. long, including securing bolt. Both items complete with instructions.

DRY REED SWITCHES

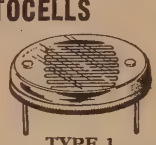
Basically a pair of gold diffused reed contacts hermetically sealed in a glass tube filled with inert gas. Contacts can be actuated by permanent or electromagnets and so form ideal devices for a wonderful range of inexpensive devices such as burglar alarms, limit switches, position indicators, r.p.m. counters, night light controls, door bell switching, level controls, etc., etc. Reed switches have tremendous reliability factors and a working life of about 100 times that of microswitches, and the uses to which they can be put is limited only by imagination. **Each switch is supplied complete with specification, instructions and ideas information. 7/- each,** *post free.* *Suitable magnets 1/- extra.*

BURGLAR ALARM KITS £4.10.0

Additional entry points 7/6 each.

All the components to make a foolproof burglar alarm system that can be applied to doors and windows to give instant and continuous warning on opening or even if wiring is cut. Based on professional types using a reed switch and magnet system which is simple to install and operate and undetectable when in place. Kit is supplied to safeguard up to 4 entries, but an unlimited number of entries can be safeguarded for only 7/6d per entry extra. **Complete kit is supplied with full instructions for installation and operation.**

CADMIUM SULPHIDE PHOTOCELLS



TYPE 1 **TYPE 2**

New, inexpensive photo-conductive cells which act as light-sensitive resistors that increase conductivity with increased light. These are 1,000 times more sensitive than selenium cells, with greater reliability, and can easily be built into a wide range of simple circuits. Typical uses include automatic light controls for home and car, flashing barricade or breakdown lights, exposure meters, brightness controls, relay operation, and many other devices. Requires only simple low power source from battery or mains transformer. Two types available:

TYPE 1.—Max. voltage 200 v. Output 0.5 W. Sens. range 400-800 mu. 10/- *post free.*

TYPE 2.—Max. voltage 150 v. Output 0.15 W. Both types have a resistance range of 5 megohms at zero to 500 ohms at 1000 lux. Sensitive range is 400-800 mu. Supplied with specification, instructions and typical circuits. 8/6 *post free.*

DIRECT READ-OUT TUBES

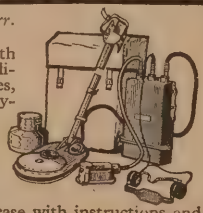
XN3 "Numicator" read-out indicators scaled 0-9 and for operation from 180-300 volts D.C. Unit is contained in cylindrical glass envelope size ⅜in. diam. × 1½in. high with wire-ended connections. Figure height ⅛in. Can be used in single circuits to give numerical indication or to form basis for electronic counters with speeds up to 5 k.c. New current production units complete with specification, performance data and typical circuits. **£1.10.0 each.**

Set of cold cathode tubes to make one counting stage of 150 c/s counter, **10/6 extra.**

Cold cathode tubes for high speed counters can also be supplied. Send for details.

MINE DETECTORS 39/6

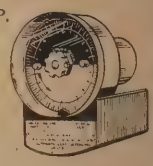
Carr. 7/6



Battery operated, completely portable with search head and collapsible handle, amplifier, control unit, lightweight headphones, test equipment and depth gauge in "carryall" haversack. Sensitivity permits detection at full volume of underground metallic objects at 2ft. and much greater depths at audible strength. **Ideal for the location of hidden water pipes, electrical cables, etc.—even, perhaps, "buried treasure"!** In original transit case with instructions and circuit diagram. Requires only 1.5 and 67.5 volts from dry batteries (not supplied). **Fully guaranteed.**

GUNFIRE TIME SWITCH 55/-

P.&P. 2/6.



Type G509 Mains Operated Time Switch originally supplied for use with Sigmund Pumps in heating installations for standard 200/250 v. A.C. 50 c/s with switch contacts rated at 20A A.C. Consists of synchronous clock motor operating two pre-set on/off contacts which can be positioned to switch on and off at any chosen time once every 24 hours. Pre-setting dial housed in hammer bronze metal case with clear plastic cover and complete unit is mounted over wall fitted push-on socket and terminal holder to facilitate removal and replacement for resetting purposes. Size overall 4½in. × 2½in. wide × 3½in. deep. Brand new in makers' cartons.

ELECTRONIC TACHOMETER £4.10.0

Carriage 3/6.

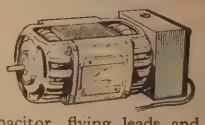
Specially made for Proops to a unique design giving greater accuracy than ever before! Uses a brand new transistor circuit operating on induction principles that does not require connection to contact breaker or interfere in any way with the engine ignition system. Can be fitted in minutes without special skill, and is supplied with a universal mounting bracket that ensures ready installation to any car where dashboard space is not available. Transistor unit utilizes printed circuit board technique and top grade components, and is entirely contained within a magnificent aircraft quality instrument with 3-inch circular dial and huge 270 deg. scale that gives really accurate, instant check readings to within 1% of engine speed up to 8,000 r.p.m. Provides a first class, dependable instrument that pays for itself quickly in essential tuning facility, economical motoring, precise gear changing, and that extra feature that earns its place in any car. **Present supplies are for 4-cylinder, 4-stroke, 12v. positive earth systems only. Complete with mounting bracket and fitting instructions.**

EXTRACTOR FANS 27/6

Post and packing 2/6.

Brand new, 230/250 volts A.C. mains operated extractor fans, complete except for external shrouding which can be readily made up from simple sheet metal wrapping to suit any particular installation. Continuously rated, smooth, silent-running induction motor; balanced 3-bladed 6in. fan. Size 7½in. diam. 4in. deep.

BEAM ROTATING MOTOR



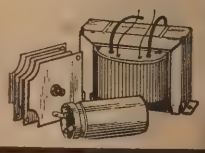
Powerful, capacitor start mains motor with integral gear-box giving output of 4 r.p.m. to female hexagonal drive of approx. ¼in. across flats. Heavy die-cast construction with life-time sealed bearings, and supplied complete with capacitor, flying leads and connection instructions. Intended for 220 v. 50 c/s. A.C. mains, but will work perfectly on 230/240 v. A.C. also. Intermittently rated with 6 minute cycle of operation. Size overall 6½in. × 3¼in. × 2⅞in. **£2.10.0** *P. & P. 2/6.*

FILAMENT TRANSFORMERS

High quality drop-through type. Size: 3 × 2½ × 3½in. deep. Input: 200/250 volts A.C., 50 cycles. Output: 6.3 volts centre tapped at 4 amps. New and guaranteed. Tremendous bargain offer, only **5/-** *Post and packing 2/-.*

1 Amp. MODEL CONTROL POWER PACK 18/6

Post and packing 2/6.



A complete kit—mains transformer, rectifier, and smoothing condensers—all the components to make a splendid 12 volts, 1 amp. power pack for model control, charging, etc. Supplied with full wiring instructions.

ELECTRO/MECHANICAL COUNTERS 10/-

Post & Pkg. 1/6.

Ultra modern, miniature style, precision made units reading 0-9999. Fitted with 300 ohm coil. Size overall only: 3⅜in. long × ⅝in. square. **In excellent guaranteed condition.**

4WW—158 **FOR FURTHER DETAILS.**

TRANSISTORS & DIODES

GUARANTEED TOP QUALITY

Huge reduction. Red Spot standard L.F. type now only **1/6**
White Spot R.F. **2/-**

Mullard Matched Output Kits OC81D and 2-OC81s) **12/6**
R.F. Kits (OC44, OC45 (2). 3 transistors. **12/6**

AF114	8/-	OC44	5/6
AF115	7/6	OC45	5/6
AF116	7/6	OC72	5/6
AF117	7/-	OC81	5/6
AF127	9/6	OC81D	5/6
OC26	12/6	OC82	6/-
OC36	14/-	OC170	8/6
	OC171	8/6	

GERMANIUM DIODES

General Purpose miniature detector, A.V.C., etc. or 6/6 doz. **8d.**

Gold Bonded highest quality. Individually tested. 9/6 doz. **1/-**

SILICON POWER RECTIFIERS

Guaranteed performance. Top Make. Tested 250 V working.

100mA (8 for 9/6) **3/9** 250mA (8 for 19/6) **7/6**

3 VALVE AMPLIFIERS

Kit of new parts, consisting chassis, mains and output transformers, valves (P61, 6G6G, 6X5G) and all components. With full instructions for making high gain amplifier with separate bass and treble controls, negative feedback, etc. Truly unusual value at **29/-**

CO-AX, low loss 6d. yd., 25 yds., 11/6, 50 yds., 22/-, 100 yds., 42/6. Co-ax Plugs 1/3. Wall outlet boxes 3/6.

SPECIAL C.R.T. OFFER

Due to huge Bulk Special Purchase we are offering MW 31/74 Tubes at the unrepeatable price of **29/-**. MW 36/24 ditto, **39/-**. P.P. 12/6. The above are guaranteed for 6 months.

LOUDSPEAKERS 3Ω Top Makes.
6½in. 7/6 5in.
8in. 8/6 7 × 4in.

MAINS TRANSFORMERS

Excellent Quality. Guaranteed Upright mounting 250-0-250V 60 mA, 6.3V 3A. **9/6**
Ditto semi-shrouded **9/6**. Ditto upright 80 mA **12/6**.

TWEETERS

Famous German electrostatic LSH75 easily fitted without extra transformer into existing radios, loudspeakers, etc. **4/6**

CONNECTING WIRE

P.V.C. Bright colours. Five 25ft. coils only. **4/-**

VALVE HOLDERS

B7G amphenol 6d. ea. ..... 5/- per doz.
B9A, 7d. ea. ..... 6/- per doz.
B9A ceramic, 7d. ea. ..... 6/- per doz.
B9A with screens, 10d. ea. .. 8/- per doz.

NEW SHOP SOUTHAMPTON

OPENING IN LARGE PREMISES

WE LOOK FORWARD TO OFFERING YOU A FIRST CLASS SERVICE FROM 18th JAN. 1964 at:

72, EAST STREET

With widest Stocks, Keenest Prices: T.Vs, Radios, Valves, Transistors, Hi-Fi Equipment, Loudspeakers, Autochangers, Cables, Components, etc.

BULK BARGAINS

12 POTS. Popular values. 5K to 2 Meg. Unused, mixed pre-set, long sp., switched, etc. **4/6**

CONDENSERS. 25 Mixed. Electrolytic. Many popular sizes. List Value £5. Our Price **10/-**

100 RESISTORS 6/6
Excellent. Sizes ½-3 watt.

100 CONDENSERS 9/6
Miniature Ceramic and Silver Mica Condensers, 3 pF to 5,000 pF. LIST VALUE OVER £5.

100 HI STABS 9/6
1% to 5% 100Ω to 5MΩ.

EKCO L.O.P.T. unused replacements for Perspex cased 1954/7 models complete with E.H.T. rect. unrepeatable **39/-**

TELEPHONE DISPATCHED C.O.D. ORDERS THE SAME DAY

VALUE!

4 watt AMPLIFIERS

excellent amplifier with high gain preamp stage, 10F3 driving 10P14 output stage, complete with 3in. speaker. In attractive 2-tone case. Tone control, negative feedback, ready for immediate use, individually tested. Amazing volume and clarity ideal for guitars, record players, p.a., in small halls, baby alarms, etc. Easily worth £5. Our price whilst stocks last. Carr, Packing, etc. 7/6. **45/-**

ALL-WAVE RADIOGRAM CHASSIS. Complete with full length dial and output transformer. Valve line up—UCH81, UF89, UBC81, UL84 and UY85. absolutely complete **£4.19**

ENQUIRIES WELCOME
Quantity Prices or Quotes for items not listed, particularly rare values.

Tubes

Carr. & Ins. 12/6.

HIGHEST QUALITY—COMPARE OUR PRICES

MOST MULLARD, MAZDA, COSSOR, EMITRON, EMISCOPE, BRIMAR, FERRANTI TYPES, PROCESSED IN OUR OWN FACTORY

	GUARANTEED 6 months	GUARANTEED 12 months	NEW TYPES
12in.	£2. 0.0	£3. 0.0	MW 31/74 £3.15.0
14in.	£2.10.0	£3.10.0	MW 36/24 £4.15.0
15-17in.	£3. 5.0	£4. 5.0	CRM 172 MW 43/64 £6.0.0
21in.	£3.15.0	£5.15.0	

KEENER PRICES ★ VALVES ★

by return of post

THE MOST ATTRACTIVE COMPETITIVE VALVE LIST IN THE COUNTRY

All valves are new and unused unless otherwise advised

POST 1 Valve 6d., 2-11, 1/- FREE for 12 or more valves.

3 MONTHS' GUARANTEE In writing with every valve.

FREE TRANSIT INSURANCE. Satisfaction or Money back Guarantee on Goods if returned within 14 days.

OZ4	4/9	6K7	7/3	20D1	8/9	DL92	3/6	EZ40	5/6	U18	7/6
1A7GT	8/-	6K7G	1/9	20F2	9/6	DL92	4/3	EZ41	6/-	U22	5/9
1C5GT	7/-	CK7GT	4/3	20L1	11/6	DL94	5/6	EZ80	4/9	U24	12/6
1D5	6/9	6K8G	4/9	20P1	9/6	DL96	6/9	EZ81	4/9	U25	8/9
1D6	9/6	6K8GT	8/3	20P3	9/6	EA50	1/3	FW4/500	7/9	U26	7/6
1H5GT	8/-	6K25	0/6	20P4	13/6	EABC80	6/3	GT1C	9/9	U31	8/9
1L4	3/3	6L1	8/9	20P5	12/6	EAC91	3/9	GZ32	7/3	U33	14/-
1LD5	4/-	6L6	7/6	25A6G	7/9	EAF42	7/6	GZ34	10/6	U35	12/6
1LN5	4/6	6L6G	6/6	25L6GT	6/-	EB34	1/3	HABC80	9/6	U37	23/3
1N5GT	8/-	6L18	7/3	25Y5G	7/9	EB41	4/6	HL41DD	8/6	U50	4/9
1R5	4/9	6L19	12/6	25Z4G	6/9	EB91	2/3	HVR2	8/6	U52	4/9
1S4	7/6	6LD20	5/9	25Z5	7/9	EBC33	5/9	KT32	6/-	U76	5/6
1S5	3/9	6N7	5/-	25Z6G	8/-	EBC41	7/6	KT33C	4/-	U78	4/6
1T4	2/9	6P1	12/6	27SU	17/6	EBC81	6/9	KT36	14/-	U107	12/6
1U5	5/3	6P25	7/-	30C1	5/3	EBF80	6/9	KT44	5/6	U191	9/6
2D21	5/3	6P28	9/9	30C15	9/3	EBF83	7/9	KT55	17/6	U281	9/-
3A4	4/-	6Q7G	5/6	30F5	6/-	EBF89	7/6	KT61	7/-	U282	12/6
3A5	8/9	6Q7GT	7/9	30FL1	9/3	EBL21	8/-	KT63	4/6	U301	11/6
3D6	4/-	6R7G	6/-	30L1	5/6	EC52	4/3	KT66	12/6	U309	5/6
3Q4	6/9	6SA7	5/9	30L15	9/6	EC91	3/-	KT76	7/9	U329	9/-
3S4	4/9	6SC7	4/6	30P4	9/6	EC92	7/6	KT88	19/-	U339	9/6
3V4	5/6	6SG7	4/6	30P12	7/3	EC91	7/3	KTW61	5/6	U403	9/9
5R4GY	8/9	6SH7	3/-	30P19	9/6	ECC32	3/9	KTW62	5/6	U404	5/9
5T4	7/9	6SJ7	5/-	30PL1	8/9	ECC33	4/9	KTW63	5/6	U801	16/6
5U4G	4/9	6SK7	4/6	30PL13	8/9	ECC34	9/-	KTZ63	5/9	UABC80	6/9
5V4G	7/3	6SL7GT	5/9	35C5	8/6	ECC35	5/9	L63	3/-	UAF42	7/-
5Y3G	4/9	6SN7GT	4/9	35L6GT	7/3	ECC40	7/6	LN152	5/9	UB41	6/9
5Y3GT	4/9	6SQ7	5/9	35W4	5/6	ECC81	3/9	MU14	5/6	UBC41	6/9
5Y4G	8/9	6S87	3/6	35Z4GT	4/9	ECC82	4/3	N37	10/6	UBC81	6/9
5Z4	9/-	6U4GT	9/3	35Z5GT	6/9	ECC83	5/6	N78	11/6	UBF80	6/9
5Z4G	7/-	6V6G	4/3	41	6/6	ECC84	6/6	N108	13/-	UBF89	7/3
5Z4GT	9/6	6V6GT	6/-	42	5/9	ECC85	6/9	N152	8/3	UBL21	10/6
6/30L2	3/3	6X4	4/6	50B5	6/9	ECC88	10/6	P41	3/6	UC92	7/6
6A6	3/9	6X5G	4/9	50C5	6/9	ECF80	6/9	P61	2/6	UCC84	6/-
6A7	9/-	6X5GT	6/-	50L6GT	7/-	ECF82	7/3	PABC80	7/6	UCC85	6/9
6A8G	5/9	7B6	3/9	53KU	9/6	ECH21	10/9	PC86	10/3	UCF80	11/9
6A8GT	12/6	7B7	7/3	61BT	17/6	ECH35	7/6	PC97	8/-	UCH21	9/-
6AC7	3/-	7C5	7/3	62BT	13/6	ECH42	7/9	PCC84	5/6	UCH42	6/9
6AG5	2/6	7C6	7/-	75	4/9	ECH81	6/9	PCC85	7/3	UCH81	6/9
6AG7	5/9	7H7	5/9	78	4/9	ECH83	7/9	PCC88	11/-	UCL82	8/6
6AK5	4/9	7R7	14/-	80	5/3	ECL80	5/9	PCC89	7/6	UCL83	9/6
6AL5	2/3	7Y4	5/-	83	9/6	ECL82	7/3	PCC189	10/6	UF41	7/6
6AM6	2/9	7Z4	5/-	185BT	19/6	ECL83	9/3	PCF80	5/9	UF42	5/3
6AQ5	5/9	8D3	2/9	185BTA	19/6	ECL86	9/-	PCF82	6/6	UF80	6/9
6AT6	5/-	10C1	9/6	307(A)	8/-	EF22	6/6	PCF84	9/3	UF85	7/-
6AU6	6/-	10C2	12/6	307E	5/9	EF36	3/3	PCF86	8/9	UF89	6/6
6AV6	5/6	10F1	6/6	813	49/-	EF37A	6/9	PCL82	6/6	UL41	6/9
6B7	3/-	10F9	10/-	832	14/-	EF39	4/6	PCL83	8/-	UL44	14/-
6B8G	3/-	10F18	9/6	866A	11/6	EF40	9/9	PCL84	6/9	UL46	8/9
6BA6	5/6	10LD11	12/6	954	5/6	EF41	6/9	PCL85	8/6	UL84	6/9
6BE6	5/-	10P13	8/3	955	2/3	EF42	5/9	PCL86	9/6	UM80	8/6
6BG6G	13/-	10P14	9/6	956	2/-	EF50-BR	1/3	PEN25	3/6	UR1C	6/9
6BH6	5/6	10P18	6/9	1625	5/6	EF50(A)	2/6	PEN45	7/9	UU6	9/9
6BJ6	5/6	12A6	2/3	5763	7/6	EF54	3/3	PEN46	5/3	UU7	8/6
6BR7	8/-	12AH8	9/-	9001	3/-	EF80	3/9	PL33	9/6	UU8	11/6
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6C5	5/6	12AV6	6/9	AZ41	6/6	EF92	2/6	PL83	5/3	VP4B	9/-
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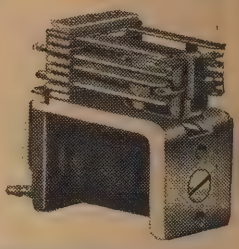

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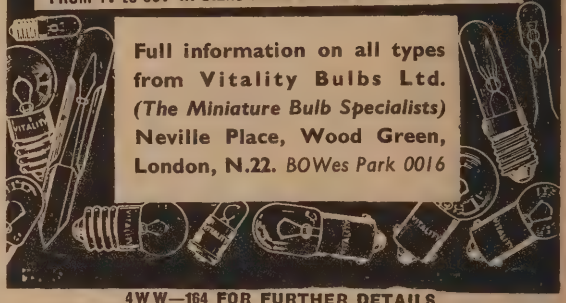

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0–300mA	2½in.	D.C.	10/-
150–0–1,500mA	3½in.	D.C.	29/-
0–15v	2½in.	A.C.	17/6
0–50v	2½in.	D.C.	28/
0–150v	2½in.	A.C.	24/-
0–500v (shunt)	2½in.	D.C.	20/-
0–5kV	3½in.	electrostatic	85/-
0–10kV	2½in.	D.C.	63/-
Freq. 0–70 c/Sec. 125v	3½in.		52/-

*Weston, as usually used also is H.R.O. as " S " meter
** Projection type.

BRAND NEW ORIGINAL SPARE PARTS FOR AR88 RECEIVERS.

I.F. TRANSFORMERS. 1st, 2nd, 3rd, 4th (for type D), **12/6** each, or complete set of 6, **60/-.**

I.F. Transformers. Crystal Load, **12/6** each.

Plates escutcheons (for D and LF), **10/-** each.

Dials (for type D), **10/-** each.

Logging dial (for D and LF), **10/-** each.

Antenna Trimmers (LF and D), **2/6** each

Filter Condenser 3 x 4μF, **15/-.**

Condensers. 3 x 25μF (D and LF), **2/6** each.

RF Antenna Inductors (D and LF), **7/6** each.

Small Mica Condensers, various values, **1/6** each.

Small Trimming Tool, 7/6.

Instruction Manual for AR88D, **£1.**

RELAYS HIGH SPEED 250 ohm + 250 ohm 15mA series 28mA single **17/6.**

RELAYS. Large selection of new relays type 600 and 3,000.

Open 9-5.30 p.m. except Thursday 9-1 p.m. PERSONAL CALLERS WELCOME

Z. & I. AERO SERVICES LTD.

PLEASE NOTE **NEW ADDRESS** OF OUR HEAD OFFICE

44A Westbourne Grove, London, W.2

Tel.: PARk 5641/2/3 **Cables: ZAERO, LONDON**

A.R.B. Approved Stockists

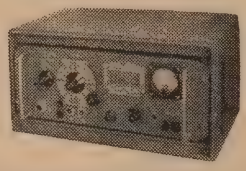
RETAIL BRANCH (personal callers only): 85 TOTTENHAM COURT ROAD, W.2. Tel.: LANgham 8403

Please send all enquiries, correspondence and Mail orders to Head Office

MARCONI TF144G "STANDARD" SIGNAL GENERATORS

Frequency Range 85 kc/s to 25 mc/s. Incremental frequency control. Calibration accuracy ±1%. Output voltage 1μV to 1V. Internal modulation 400 c/s. up to 75% depth. Output impedance 10Ω and 52.5Ω. Fully overhauled to the original specification, complete with R.F. lead with Dummy Aerial and Mains lead. **£85 0 0**

MARCONI TF934 DEVIATION TEST SET



Fundamental frequency range 2.5-100 Mc/s basic; range can be extended to 500 Mc/s. by using harmonics. Deviation range 0-5, 0-25 and 0-75 kc/s. in the modulation range of 50 c/s. to 15 kc/s. Sensitivity better than 55 mV. Power supplies 100-150 and 200-250 v. A.C. Price fully overhauled and guaranteed **£85 0 0**

MARCONI TF-801A SIGNAL GENERATORS

Frequency range 10-300 Mc/s. in four overlapping bands calibration accuracy ±1%. Output 200 mV. max. into 75Ω. Calibrated step attenuator 0 to −100 dB in 1 dB steps. Internal sinewave (up to 80%) and square wave (50-50) modulation at 400, 1,000 and 5,000 c/s. Provision for internal modulation. Power requirements 100-130 and 200-250 v. A.C. Fully overhauled and guaranteed PRICE **£85 0 0**

MARCONI FM-AM SIGNAL GENERATORS

TF948 (SERVICES TYPE No. 13). Frequency range 20-80 mc/s. in two bands. Built-in crystal calibrator with loudspeaker beat indicator. Continuously variable output from 1μV to 100 mV. into 75Ω and fixed high output of 1 volt.

Internal modulation at 300-1,000-1,600-3,000 c/s.; A.M. up to 80% and F.M. up to ±600 kc/s.; square wave 50—50. Provision for external modulation. Both A.M. and F.M. modulation can be monitored with an accuracy of approx. 5% F.S.D. Power supplies 100-150V. and 200-250V. A.C. Signal generator chassis in shock-mounted in a pressed steel case, fitted with screw-down cover which can be used as transit case.

Price, fully overhauled and guaranteed is **£220**

REMANENT TELEPHONE CROSSBAR RELAYS

The relay consists of 5 cross-bar Units of 8 make contacts each, operated by separate 820Ω coils and one 1,000Ω main coil of the P.O. 3000 Type. The latter is fitted with two sets of auxiliary changeover contacts.

PRICE, brand new (p. & p. 5/-) **35/-**

WIRE WOUND RESISTORS

25Ω, 6w...	1/-	25Ω, 10w.	1/-		
47Ω, 15w.	1/6	110Ω, 1½w.	9d.	30Ω, 6w...	1/-
390Ω, 4.5w.	1/-	750Ω, 6w.	1/-	130Ω, 6w.	1/-
1k, 10w.	1/6	1.5k, 4.5w.	1/-	1k, 6w. ..	1/-
2k, 15w...	1/6	3.3k, 10w.	1/6	1.8k, 10w.	1/6
5.6k, 30w.	1/9	11k, 6w...	1/6	4.7k, 10w.	1/6

12 resistors of any size **11/-** post paid.

POTENTIOMETERS

WIRE WOUND:

5Ω 1w, ⅜in. spindle **2/-**; 100Ω 1w.,1in. spindle **2/-**; 1,000 Ω 2.5w., ⅜in. spindle **2/6**; 10,000Ω 2.5w., ⅜in. spindle **2/6**; 50,000Ω, 1w., ⅜in. spindle **2/-**; 50,000Ω 2.5w., ⅜in. spindle **2/6**; 100kΩ Precision, 5w., 1in. spindle **5/-**.

CARBON TRACK:

10k, 1½w., 1in. spindle, Linear **1/6**; 25k 2.5w., 1in. **1/9**; 250k., ¼w., 1in. spindle Linear **1/6**.

Packing and postage, 9d. per potentiometer. Orders for any six—post paid.

HIGH STABILITY RESISTORS

We have comprehensive assortment of high stability resistors in most standard values from ⅛ to 1½w., at a tolerance of 1, 2 and 5%. Price: 5% **6d.**; 2% **9d.**; 1% **1/-**.

SPECIAL OFFER

High stability resistors, 1000Ω 1% ⅛w. High stability resistors 390Ω 1% ¼w. Price **7/6** for ten, post paid.

TANGENTIAL BLOWERS

230 v. A.C. motor driving a 2½in. dia. × 7in. long. Centrifugal blower. Outlet size 1½in. × 7in. Suitable for cooling and ventilating interiors of electrical equipment or for blowing hot air when used in conjunction for ordinary fire elements. Two bolt mounting. Brand new. **35/-**. P.P. 7/6.

TELEPHONE DIALS

"Provincial" Type Automatic Telephone Dials, with numbers only, recovered from equipment, in good condition. **12/6**. P.P. 1/9.

METERS

50 μA. D.C. MC. 2½in. Rd. Proj.	45/-
500 μA D.C. MC. 2in. Rd. Fl. Victoria	20/-
500 μA. D.C. MC. 1in. Rd. P.M. scaled 0-1 mA. ..	22/6
500 μA. D.C. MC.2in. Rd. Fl. Cal. 0-15/300 V ..	25/-
500 μA. D.C. MC. 2in. Rd. P.M. Cal. 0-5, Turner..	30/-
1 mA. D.C. MC. 1½in. Rd. P.M. G.E.C.	30/-
1 mA. D.C. MC. 2in. Rd. P.M. Cal. 0-3/300	25/-
1 mA. D.C. MC. 2½in. Rd. P.M. Ironclad	30/-
1 mA. D.C. MC. 2½in. Rd. P.M. Ferranti, supplied with loose square flange	30/-
5 mA. D.C. MC. 3½in. Rd. Fl., Turner	55/-
10 mA. D.C. MC. 2in. Rd. Fl., G.E.	20/-
10 mA. D.C. MC. 2½in. Rd. Fl.	25/-
15-0-15 } 30-0-30 } mA. D.C. MC Twin Range 2½in. Rd. Fl.	25/-
25 mA. D.C. MC. 2½in. Rd. Fl.	30/-
30 mA. D.C. MC. 2½in. Rd. Fl.	25/-
50 mA. D.C. MC. 2in. sq. Fl. Weston	22/6
50 mA. D.C. MC. 2½in. Rd. Fl.	30/-
75 mA. D.C. MC. 1½in. Rd. P.M. G.E.C.	20/-
75 mA. D.C. MC. 2½in. Rd. Plug-in	15/-
100 mA. D.C. MC. 1½in. Rd. P.M. G.E.C.	20/-
100 mA. D.C. MC. 1½in. Rd. Fl.	20/-
100 mA. D.C. MC. 2½in. Rd. Fl.	25/-
150 mA. D.C. MC. 1½in. Rd. P.M.	20/-
150 mA. D.C. MC. 2in. sq. Fl.	25/-
150 mA. D.C. MC. 2½in. Rd. Fl.	20/-
200 mA. D.C. MC. 2in. Rd. Fl.	20/-
200 mA. D.C. MC. 2½in. Rd. Fl.	25/-
250 mA. D.C. MC. 2½in. Rd. Fl.	25/-
300 mA. D.C. MC. 2½in. Rd. Fl.	25/-
500 mA. D.C. MC. 2in. Rd. Fl.	20/-
500 mA. D.C. MC. 2½in. Rd. Fl.	25/-
1 A. D.C. MC. 2in. Rd. Fl.	25/-
1 A. D.C. MC. 2½in. Rd. Fl.	27/6
1 A. D.C. MC. 2½in. Rd. Proj.	17/-
2 A. D.C. MC. 2in. Rd. Fl.	25/-
2 A. D.C. MC. 2½in. Rd. Fl.	27/6
2.5 A. A.C. MI. 2in. sq. Fl.	20/-
3 A. D.C. MC. 2½in. Rd. Fl.	27/6
5 A. D.C. MC. 2½in. Rd. Fl.	27/6
8 A. D.C. MC. 2½in. Rd. Fl.	30/-
8 A. A.C. MI. 2in. sq. Fl.	25/-
10 A. D.C. MC. 2½in. Rd. Fl.	30/-
20 A. D.C. MC. 2in. Rd. Proj.	15/-
25 A. D.C. MC. 3½in. Rd. Proj.	17/6
25 A. A.C. MI. 3½in. Rd. Fl.	25/-
50 A. D.C. MC. 2½in. Rd. Fl.	30/-
100 A. A.C. MI. 2½in. Rd. P.M.	17/6
8 volts D.C. MC. 3⅛in. sq. Fl.	45/-
15 volts A.C. MI. 2½in. Rd. Fl.	30/-
150 volts A.C. MI. 2in. Rd. Fl.	25/-
150 volts D.C. MC. 2in. Rd. Fl.	25/-
150 volts A.C. MI. 3½in. Rd. Proj.	20/-
300 volts, A.C. Rect. 2½in. Rd. P.M.	30/-
500 Volts D.C. MC. 2½in. Rd. Fl.	30/-
1500 volts Electrostatic 2½in. Round, plug-in, Ferranti	30/-

RADIO FREQUENCY METERS

200 MA. 2in. Round Plug-in	12/6
300 mA. 2½in. Round Flange	25/-
350 mA. 2in. Round Plug-in	12/6
500 mA. 2in. Round Flange	25/-
4 amp., 2in. Round Flange	20/-
10 amp., 2½in. Round Flange	22/6
15 amp. 2½in. Round Flange	22/6

VACUUM TIME DELAY RELAYS TYPE 501

Glass bulb octal base Thermal switch. Filament voltage 6.3V. Contact rating 3A at 150 V. D.C. or 250V. A.C. (One "make" contact). Delay time 60 sec. nominal, adjustable from approx. 40 to 80 sec. by ranging filament volts. **8/-**. P.P. 9d.

MINIATURE CARBON TRACK 5KΩ EDGEWISE VOLUME CONTROLS, WITH SWITCH

With enclosed switch **5/3**
With open type switch **4/-**
P.P. 9d.

PHONO-PLUGS

Standard Igranic type single pin plugs suitable for microphone, extension loudspeaker, etc. Fits all standard sockets. **2/6**. P.P. 9d.

OUR NEW CATALOGUE OF TEST EQUIPMENT IS NOW READY, AND AVAILABLE FREE OF CHARGE FOR BONA FIDE TRADE CUSTOMERS, UNIVERSITIES, ETC. PRIVATE ENQUIRERS PLEASE ENCLOSE 2/6 P.O.

DOUGLAS TRANSFORMERS

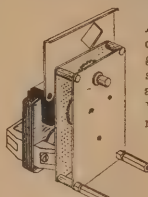
Battery charging. Input 200-250 v.
MT3/AT, output 12-15-20-24-30 v. at 2 a. **25/6**
MT16/AT, output 24 v. at 5 a. **38/6**
MT21/AT, output 12-15-20-24-30 v. at 4 a. **38/-**
Stepdown Transformers, MT4/AT 115/230 v., 150 watts **25/6**
Packing and carriage 5/-.

SCREENED POWER TRANSFORMERS for 200 to 250 v. A.C. input

Output 450/400/0/400/450 V. at 180 mA., 0-4-6.3 v. at 4A, 0-4-5 V. at 4A. two outputs 0-4-6.3V. at 3A **35/-**
Output 350/300/0/300/350 V. at 200 mA., 0-4-5 V. at 3A, 0-4-6.3 V. at 3A and two outputs 0-4-6.3 V. at 4A. **35/-**
Packing and carriage 10/- per transformer.

A.C. ELECTRIC MOTORS

REDUCTION GEAR MOTOR



Approx. 8 watts 5 minute rating on 230V, A.C. output. 4-stage gearbox provides output shaft speed of approx. 14.5 r.p.m. with a torque exceeding 1 foot-pound. With voltage reduced to 180V. the motor will operate continuously. Shaft ¼in. dia. Overall dimensions 2¼in. × 3¼in. × 3in.

PRICE **12/6**
P.P. 2/6.

VARIABLE AUTO-TRANSFORMERS Type B-2

Input 230 v. A.C. 50-60 c/s. Output adjustable from p to 260 v. at a maximum current of 2.5 amps. Scale graduated in volts. Dimensions: 5¼in. dia. × 4¼in. high. Fixing: Three 2in. dia. holes on a pitch circle of 5¼in. dia. PRICE, brand new **£5 19 6**
Packing and carriage 11/6.

POWER UNITS TYPE W8856A

This is a Navy version of Type 3 Power Unit. 19in. rack mounting. Input 230 v. Fully smoothed H.T. output can be adjusted from 180 to 270 v. at 80 mA. by means of primary taps. L.T. output 6.3 v. A.C. at 4 amps. A.C. voltmeter monitors A.C. mains input and, with key switch depressed H.T. output. PRICE second-hand, in good condition, **£3/10/-**. P.P. 15/-.

EX P.O. MAGNETIC COUNTERS

500Ω Coil, energised by 24 v. D.C. four digit electro magnetic fast acting counters (non-cancelling type counting up to 9999. Perfect condition, **8/6**. P.P. 1/6

BRAND NEW SEALED RELAYS

S.T.C. 4184GE, 2 C.O., 2,500Ω 48 V.	13/-
55190, 1 C.O., 300Ω, 9 V.	8/-
CR2791, 1 C.O., 100Ω, 6 V., Plug-in	8/-
80332, 1 C.O., 10,000Ω, 24 V., Plug-in	10/-
90327, 1 C.O., 2,500Ω. 12 V.	8/-
G8755-1Y, 1M, 65 + 5,000Ω, 15 V.	12/6
T-162F1, 1 C.O., 10,000Ω, 48 V. Plug-in	12/6
MH1769, 2 C.O., 270Ω, 3V Plug-in	7/6
E8904-1, 2 C.O., 300Ω, 9 V., Plug-in	7/6
B8743-1, 2 C.O., 680Ω, 24 V.	8/-
B8744, 2 C.O. + 1M, 400Ω, 6 V.	8/-
F8949-1Y, 3B, 2 × 16,000Ω, 48 V., Plug in	15/-
5724-1328HX, 4 C.O., 400Ω, 12 V.	8/6
22240-4, 6 M., 200Ω, 12 V.	10/-

Packing and postage 1/- per relay.

OPEN TYPE MINIATURE RELAYS

*S.T.C. 250Ω, 1M, heavy duty	6/-
*S.T.C. 700Ω, 2 C.O.	6/-
*Allied Control A102817, 75Ω, 1M, 12 v.	1/6
R.B.M. 55251 270Ω, 1M, 12 v.	3/6
R.B.M. 55528, 130Ω, 6M, 24 v.	6/6
R.B.M. 55530, 130Ω, 3M + 1 C.O., 24 v.	6/6

*Reclaimed from equipment. The remaining relays are brand new.

HIGH FIDELITY RECORDING TAPES

5in. Standard, 600ft.	10/6
5in. Long Playing, 900ft.	13/-
5in. Double Playing, 1,200ft.	16/-
7in. Standard, 1,200ft.	12/-
7in. Long Playing, 1,800ft.	18/-
7in. Double Playing, 2,400ft.	28/-

Packing and postage 1/9 per tape.

MINIATURE VOLTMETERS—BATTERY INDICATORS

Reading from 4.5 to 8 v. D.C. (suppressed zero). 1¼in. dia. scale, flange mounted **15/-**
Packing and carriage 1/6.

4WW—167 FOR FURTHER DETAILS.

TRANSISTORS

MULLARD

OC28	17/6	OC71	5/-	OC78D	7/-
OC35	15/-	OC72	8/-	OC81	7/-
OC44	6/-	OC75	6/-	OC81D	7/-
OC45	6/-	OC76	6/-	OC139	12/-
OC70	5/-	OC78	7/-	OC170	8/-

R.C.A.: 2N410, 465 kc/s. I.F. 4/3
2N412, 540 to 1600 kc/s. converter 4/3

MICRO-ALLOY:

MAT101 (up to 60 mc/s.) 8/6; MAT121 (120 mc/s) 8/6.

NEWMARKET: V8 30/20 10/-; V30/30P ..... 12/-.

TEXAS N-P-N: 28002 20/-; 28004 20/-; 28006 20/-; 2N697 15/-.

SURPLUS TRANSISTORS: Substandard: OC44 2/9; OC45 2/9. Spot Transistors: Red 2/8. White 2/8. Yellow 1/10. Green 1/6.

2.25W ZENNER DIODES

4.25 V. ± .3 V. (VR 425); 4.75V. ± .3V. (VR 475); 5.25V. ± .3V (VR 525); 5.75 V. ± .35 V. (VR 575); 6.25 V. ± .35 V (VR 625); 7.0 V. ± .6 V (VR 7B); 9.0 V. ± .6 V (VR 9B)—all at 6/6 each.
10.0V. ± .6 V. (VR 10B); 11.0 V. ± .6 V. (VR 11B)—all at 7/- each.

SEMICONDUCTOR RECTIFIERS

GERMANIUM JUNCTION, STUD-MOUNTED:
GJ5M, 300 p.i.v., 1 amp. max. 3/6
GJ7M, 80 p.i.v. 1 amp. max. 3/6

SILICON JUNCTION, WIRE ENDED:

BY100, 700 p.i.v., 450 mA. 8/-

LUCAS DD058, 800 p.i.v., 500 mA.; Direct replacement for DRM, RM, HT and 14A series rectifiers 12/6

KLYSTRONS

2K25	£4	723A/B	£3	KRN6/2	£4
2K28	£10	726A	£4	KRN6/3	£5
2K33	£45	726B	£5	K301	£4
2K41	£30	5751	£50	8AL39	£200
2K45	£7	5836	£25	8AL89	£200
2K48	£18	6470	£75	VR35A/1K	£10
3K23	£60	CV67	£5	VA220E	£35
417A	£2	CV2116	£10		
707B	£3	KRN2A	£4		

CATHODE RAY TUBES

2AP1	25/-	5SP7	100/-	09J	80/-
3AP1	22/6	5UP7	60/-	VCR97	40/-
3FP7	12/-	7BP7	15/-	VCR138	50/-
3JP7	100/-	913	50/-	VCR138A	60/-
5CP1	30/-	ACR10	20/-	VCR517B	
5FP7	12/6	09D	80/-	or C	40/-

Tube Base: 2AP1 3/6; 3AP1 1/6; 5FP7, 7BP7, 913 1/-; 3FP7, 3JP7, 5CP1, 5SP7 3/6; ACR10, 09D, 09J 2/6; 5UP7 3/-; VCR97, VCR138, VCR517 3/6.

SIGNAL DIODES

OA81	1/6	IN38A	4/-	CV112	8/-
IN21	4/-	IN70	4/-	CV442	1/3
IN23	4/-	IN72	4/-	CV2226	30/-
IN23B	4/6	IN81	4/-	CV2258	30/-
IN23C	8/-	CK708	4/-	CV2355	100/-
IN25	9/-	CV101	5/-	8X642	3/6
IN28	20/-	CV102	5/-	8X643	15/-
IN34A	4/-	CV103	5/-	8X781	4/6

OUR NEW PRICE LIST OF VALVES AND TUBES IS READY AND AVAILABLE UPON SENDING 6d. STAMP.

MAGNETRONS

2J27	£3	5J26	£25	M521	£35
2J31	£5	725A	£3	M551	£25
2J48	£10	M501	£8	JP9-7A	£12/10
2J50	£5	M502A	£35	JPT9-60	£40
2J54	£5	M508	£12/10	JP9-80	£25
4J31	£35	M518	£12/10	JP9-250	£25
4J50	£35	M518A	£35	JP9-15	£12/10
4J52A	£25				

SELENIUM RECTIFIERS

MINIATURE TUBULAR WIRE ENDED, D1601. Capacative load: 140 V. r.m.s. in., 140 V. D.C. at 15 mA. Resistive load: 230 V. r.m.s. in, 90 V. D.C. at 15 mA. 2/- each.
CONTACT COOLED: 230 V. r.m.s. input, 300 mA. D.C.; Half Wave 3/6; Voltage Doubler 4/-.
HT and EHT TUBULAR

16HT40, 540 V. r.m.s., 6 mA. D.C.	4/-
T16HT56, 750 V. r.m.s., 6 mA. D.C.	4/-
T36EHT30, 810 V. r.m.s., 2 mA. D.C.	5/-
T36EHT60, 1080 V. r.m.s., 2 mA. D.C.	5/6
T36EHT90, 2430V. r.m.s., 2 mA. D.C.	6/6

"ELECTRON" OUTDOOR ROD AERIAL

3 strong tubular light alloy sections 3ft. long each on an insulated aerial base fitted with wall mounting bracket. Complete with down lead. PRICE, brand new, 15/-. P.P. 5/-.

MINIATURE VALVE BASES AND SCREENING CANS

B7G, skirted, flange fixing, PFTE	1/6
B7G, skirted, 3-lug fixing, PTFE	1/3
B7G, skirted, flange fixing, phenolic	1/-
B8A, skirted flange fixing, phenolic or ceramic	1/-
B9A, skirted, flange fixing, phenolic	1/-
Screening cans for B7G, short	4d.
long	5d.
Screening cans for B9A, long	5d.

FULLY GUARANTEED FIRST QUALITY UNUSED VALVES

OA2	6/-	4E27	60/-	6F6G	5/-	10P14	12/-	30PL1	10/6	4017B	60/-	AZ1	9/-	EBC81	6/6	EL71	17/-	N78	15/0	R17	8/-	UU5	7/
OA3	11/-	5B/258M		6F7	5/-	11E2	20/-	35L6GT	7/-	4022AR		AZ31	8/-	EBC90	4/-	EL81	8/6	NR88	12/6	R18	7/6	UU6	11/6
OA4G	17/6		30/-	6F13	6/6	11E3	20/-	35W4	5/-		15/-	AZ41	6/6	EBC91	6/-	EL83	7/-	NSP1	25/-	R19	7/-	UY21	8/-
OB2	6/-	5D21	70/-	6F17	6/-	12A6	3/-	35Z4G	5/-	4064B	35/-	B65	4/6	EBF80	6/6	EL84	5/-	NSP2	22/-	RL18	12/6	UY41	5/6
OB3	6/-	5R4GY	9/-	6F32	3/-	12AH7GT		35Z4GT	6/-	5514	50/-	B84A	30/-	EBF83	7/6	EL85	8/-	P41	8/-	S130	12/6	UY85	5/-
OC3	5/6	5U4G	5/-	6F33	5/-		5/-	35Z5GT	6/-	5517	6/-	B364	40/-	EBF89	6/9	EL86	7/6	PABC80	7/-	S130P	15/-	VGT128	
OD3	5/-	5U4GB	6/-	6H6	1/6	12AH8	11/-	42	5/-	5651	8/-	BT19	30/-	EBL1	11/-	EL90	6/-	PC97	8/6	SC1/1000			10/-
OZ4	5/-	5V4G	8/-	6J4	9/-	12AT6	5/-	50B5	8/-	5654	8/-	BT35	30/-	EBL21	11/-	EL821	6/-	PCC84	5/6		40/-	V1507	5/-
1A3	3/-	5Y3G	4/-	6J5	5/-	12AT7	4/-	50C5	6/6	5663	7/-	BT45	200/-	EC52	4/6	EM80	6/6	PCC85	7/-	SC1/1400		VP41	5/-
1A5GT	5/-	5Y3GT	5/-	6J6	3/6	12AT7WA		50CD6G		5670	10/-	BT79	30/-	EC81	8/-	EM81	7/6	PCC88	10/6		40/-	VR21	3/6
1A7GT	8/-	5Z4	9/-	6J7G	5/-		6/-		25/-	5687	8/-	BT83	60/-	EC90	2/6	EM84	8/-	PCC89	10/-	SP2	3/6	VR56	3/-
1B63A	70/-	5Z4GT	8/-	6K6GT	6/6	12AU6	6/-	50L6GT	6/6	5691	25/-	C1B	22/6	EC92	6/6	EM85	9/-	PCF80	5/6	SP41	4/-	VR57	6/-
1C5GT	7/-	6A6	6/-	6K7	5/-	12AU7	5/-	53KU	9/-	5696	6/-	C1C	5/-	EC40	9/-	EM31	10/-	PCF82	8/6	SP61	4/-	VR66	3/-
1D5	7/6	6A8G	6/-	6K7G	2/-	12AV6	7/-	57	6/-	5702	15/-	C1K	40/-	EC81	4/-	EN32	10/-	PCF84	10/-	STV280-40		VR75/30	
1G6GT	7/-	6AB4	6/6	6K8	8/-	12AX7	6/-	71A	7/-	5718	7/6	C3JA	80/-	EC82	5/-	EN91	6/-	PCF86	8/-		20/-		11/-
1H6GT	8/-	6AB7	4/-	6K8G	4/-	12AY7	10/-	75	5/6	5725	10/-	C16J	200/-	EC83	6/-	EN93	15/-	PCL81	9/-	STV-280-80		VR78	3/-
1L4	2/6	6AC7	3/-	6L6	9/-	12B4A	9/-	76	5/-	5726	7/-	CL33	9/-	EC84	6/6	EY51	7/-	PCL82	6/6		60/-	VR92	2/-
1L6	17/6	6AF4	11/-	6L6G	6/-	12BA6	6/-	77	5/-	5727	10/-	CY31	6/6	EC85	6/6	EY81	9/-	PCL83	8/3	TDO4/20		VR99A	8/-
1N5GT	8/-	6AG5	2/6	6L7	5/-	12BE6	5/-	80	6/-	5749	9/-	DA30	20/-	EC88	10/-	EY84	7/6	PCL84	7/-		70/-	VR101	12/6
1R5	5/-	6AG7	6/-	6L18	8/-	12BH7	8/-	83	8/-	5751	11/-	DA41	30/-	EC91	3/6	EY86	5/6	PCL85	7/6	TH233	7/-	VR102	10/-
1S4	5/-	6AH6	11/-	6N7	6/-	12BY7	10/-	83V	7/6	5763	10/-	DA100	80/-	ECF80	7/6	EY91	3/-	PCL86	9/-	TP25	5/-	VT4C	20/-
1S5	4/6	6AK5	5/-	6Q7G	6/-	12C8	3/-	85A2	8/6	5787	10/-	DAC32	8/-	ECF82	7/-	EZ40	5/6	PEN4A	7/6	TT11	3/-	VT52	3/-
1T4	3/-	6AK5W	8/-	6R7	6/-	12E1	20/-	90AV	15/-	5814	9/-	DAF91	4/6	ECH21	10/-	EZ41	6/6	PEN45	7/-	TT12	60/-	VT501	3/-
1U4	5/-	6AK6	7/-	6SA7	8/-	12H6	3/-	90C1	8/-	5840	10/-	DAF92	6/-	ECH35	10/-	EZ80	5/6	PEN45DD		TT15	35/-	VU39	5/-
1U5	6/-	6AL5	3/-	6SC7	8/-	12J5GT	3/-	95A1	5/6	5879	12/-	DAF96	6/-	ECH42	8/-	EZ81	4/6		12/-	TZ40	30/-	VU111	5/-
1X2A	7/-	6AM4	18/6	6SG7	5/-	12J5WGT		150B3	10/-	5949	400/-	DDL4	4/-	ECH81	6/-	EZ90	4/-	PEN46	6/-	U12/14	8/-	VU120A	
1X2B	7/-	6AM5	2/6	6SH7	3/-		6/-	211	30/-	5965	5/-	DF33	8/-	ECH83	7/6	PEN453DD		PEN463D		U22	7/6		10/-
2C26	3/-	6AM6	4/-	6SJ7	8/-	12J7GT	7/6	220TH	5/-	5998	15/-	DF91	3/-	ECL80	6/-	FW4/500	7/-		10/-	U24	12/6	W81M	6/-
2C39A	80/-	6AQ5	6/-	6SK7	4/6	12K7GT	7/-	416B	240/-	6005	7/6	DF92	2/6	ECL82	7/6	FW4/800		PL36	8/-	U25	11/-	X65	5/6
2C40	70/-	6AR6	6/-	6SL7GT	5/-	12K8	10/-	705A	15/-	6060	6/-	DF96	6/-	ECL83	10/-	G24H	15/-	PL38	16/-	U50	5/-	X66	8/-
2C42	25/-	6AR8	5/-	6SN7GT	4/6	12Q7GT	5/-	715A	30/-	6073	7/6	DH63	6/-	ECL86	10/-	G150/2D		PL81	7/-	U76	5/-	Z63	9/-
2C43	60/-	6AS7G	22/6	6SQ7GT	5/-	12SA7	7/-	715B	60/-	6080	25/-	DK32	8/-	EF22	7/-		10/-	PL82	5/6	U191	11/-	Z66	15/-
2C46	30/-	6AT6	4/-	6SR7	8/-	12SC7	4/-	715C	70/-	6094	70/-	DK40	11/-	EF36	4/6	GM5B	15/-	PL83	6/6	U251	12/6	Z800U	20/-
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2C51	12/-	6AV6	6/-	6SU7GT		12SH7	3/-	724B	15/-	6101	7/-	DK92	6/6	EF39	4/-	GT3	15/-	PM84	10/-	U282	14/-	CV52	80/-
2C52	12/-	6B7	5/-		10/-	12SJ7	5/-	805	40/-	6110	20/-	DK96	6/6	EF40	9/-	GU50	25/-	PSG8	8/-	U301	12/-	CV413	10/-
2CW4	14/-	6B8	5/-	6T8	6/-	12SK7	5/-	807	9/-	6135	10/-	DL33	7/-	EF41	6/9	GZ30	10/-	PT15	10/-	U403	11/-	CV434	20/-
2D21	6/-	6B8G	2/6	6U4GT		12SL7GT		813	55/-	6136	9/-	DL68	10/-	EF42	6/-	GZ32	10/-	PT88	10/-	U801	20/-	CV465	5/6
2E26	30/-	6BA6	4/9		10/6		7/6	814	20/-	6146	27/6	DL69	12/6	EF80	5/-	GZ34	10/-	PY80	5/6	UABC80	5/-	CV466	5/-
2X2	3/-	6BE6	5/-	6U7G	10/-	12SN7GT		815	40/-	6147	17/-	DL91	5/-	EF83	10/-	GZ37	9/-	PY81	5/6	UAF42	8/-	CV467	5/-
2X2A	7/-	6BH6	7/-	6V6	9/-		7/6	829B	50/-	6186	10/-	DL92	5/-	EF85	6/-	HF93	6/-	PY82	5/-	UBC41	6/6	CV468	5/-
3A4	4/-	6BJ6	8/-	6V6G	4/-	12SQ7	10/-	832	20/-	6463	7/-	DL93	4/-	EF86	6/-	HL2	3/-	PY83	6/-	UBC81	7/6	CV469	8/6
3A5	7/-	6BQ7A	8/-	6V6GT	5/6	12SR7	5/-	832A	45/-	6621	10/-	DL94	5/6	EF89	4/8	H12K	3/-	PY88	8/6	UBF80	6/6	CV472	5/-
3A/167M		6BR7	11/6	6X4	4/-	12SY7	6/-	838	12/-	7586	22/6	DL95	6/6	EF92	2/-	HL23	8/-	PY800	8/6	UBF89	7/-	CV473	12/6
	30/-	6BR8	5/-	6X5	4/6	13D3	8/-	866A	14/-	9002	5/6	DL96	6/-	EF93	4/9	HL23DD	6/-	PY801	8/6	UBL21	11/-	CV474	10/-
3B7	5/-	6BW6	9/-	6X6GT	5/6	19AQ5	8/6	872A	35/-	9003	7/6	DM70	5/-	EF94	7/-	HL41DD		PX4	15/-	UCC84	9/-	CV475	8/-
3B24W	12/-	6BW7	9/-	6Y6G	6/-	19BG6G		884	10/-	9004	2/6	DY80	7/-	EF95	5/-		9/-	PX25	10/-	UCC85	6/6	CV476	5/-
3B28	15/-	6C4	2/6	6Z4	5/-		10/-	931A	60/-	9006	2/6	DY86	8/-	EF96	2/6	HY90	5/-	PZ30	15/-	UCF80	9/6	CV2101	7/-
3C45	30/-	6C5GT	6/-	7B7	8/-	20L1	14/-	954	5/-	A207	80/-	E92CC	7/-	EF98	10/-	KT2	5/-	QP25	5/-	UCH21	8/6	CV2102	10/-
3CX100A5		6C6	4/-	7C5	10/-	20P1	14/-	955	3/-	A1820	20/-	E180CC		EF183	8/-	KT8	5/-	QQV02-6		UCH42	7/-	CV2103	7/-
	100/-	6C8G	7/-	7C6	7/-	20P3	12/-	956	2/-	A2293	17/6		10/-	EF184	8/-	KT33C	6/-		45/-	UCH81	7/-	CV2105	8/-
3D6	4/-	6CB6	5/-	7C7	5/-	25L6GT	8/-	957	5/-	AC/P4	7/6	E180F	15/-	EH90	7/3	KT41	7/6	QQV03-10		UCL82	8/-	CV2260	5/-
3E29	50/-	6CD6GA		7H7	8/-	25Z4G	6/6	958	4/-	AC5/		E181CC		EK90	5/-	KT44	5/-		35/-	UCL83	10/-	CV2341	
3Q/195E			18/-	7Q7	7/-	25Z5	7/6	959	8/-	PENDD	8/-		10/-	EL32	3/-	KT61	9/-	QQV03-20		UF41	7/6		200/-
	700/-	6CH6	6/-	7S7	16/-	25Z6GT	8/6	1616	7/-	AC6/PEN		E182CC		EL33	9/-	KT63	6/-	QS75-60	20/-	UF42	7/-	CV4003	10/-
3Q4	6/6	6CL6	10/-	7Y4	7/-	27M1	60/-	1619	7/-		6/-		10/-	EL34	10/-	KT66	15/-	QS1200	12/-	UF80	6/6	CV4004	
3Q5GT	7/6	6CW4	14/-	8D2	3/6	28D7	7/-	1625	6/-	ACT22		EA50	2/-	EL36	10/-	KTW61	7/-	QV03-12		UF85	7/-		10/-
3S4	5/-	6D4	15/-	9BW6	11/-	28D7W	15/-	1626	3/-		240/-	EABC80	6/-	EL37	17/6	L63	6/-		10/-	UF86	12/-	CV4014	8/-
3V4	5/6	6D6	3/	10C2	13/-	29C1	20/-	1629	6/-	ATP7	6/-	EAF42	8/6	EL38	17/6	MH4	5/-	QV04-7	10/-	UF89	6/-	CV4024	6/-
4B26	35/-	6D8G	15/-	10D1	7/-	30F5	8/-	2050	12/-	APR3	3/-	EBC33	6/-	EL41	7/3	MHL4D		QV06-20		UF91	6/-	CV4025	7/-
4D1	4/-	6EV5	12/-	10F9	10/-	30P19	14/-	2051	6/-	ARP12	3/6	EBC41	6/9	EL42	8/-		12/6	R10	15/-	UL84	6/-	CV4046	50/-

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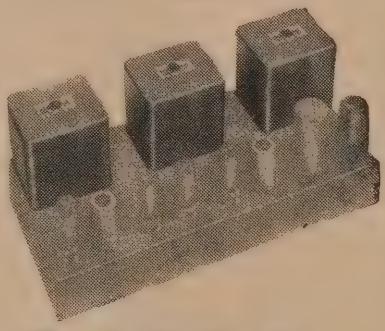

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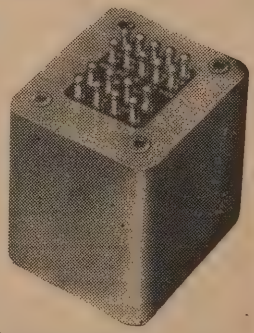

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EXPERIMENTAL Officer/Assistant Experimental Officer for provision and programming of instrumentation facilities to meet the requirements of trials and proof of weapons, ammunition etc. on the range. Also, instrumentation developments on new techniques, particularly sophisticated systems, and liaison with Trial Authorities.
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FOR SALES AND WANTED ADVERTISEMENT FORM TURN TO PAGE No. 133

SINGAPORE TELEVISION SERVICE

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For applicants who are Corporate or Graduate Members of British Institute of Electrical Engineers or have equivalent qualifications. In addition, two years' post-qualification training in the operation, maintenance, design, manufacture and installation of Radio and/or Television broadcasting equipment is essential.

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Windscale and Calder Works require experienced men with knowledge of electronic equipment and/or industrial instrumentation for fault diagnosis, repair and calibration of a wide range of instruments used in nuclear reactors, radiation laboratories and chemical plant. This work involves the maintenance of instruments using pulse techniques, wide band low noise amplifiers, pulse amplitudes analysers, counting circuits, television and industrial instruments used for the measurement of pressure, temperature and flow.

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We have an immediate vacancy for a Junior in the Design Engineering Department of an expanding Division in a medium sized Company. Qualifications—an approved electrical apprenticeship, preferably on Transformers, with particular emphasis on Transformers for Electronic Equipment. National or Higher National Certificate preferred.
Contributory pension and free life assurance schemes, modern canteen facilities.
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DUTIES: At Henlow, the calibration of a wide range of electronic equipment and the compilation of calibration manuals. At other units, the technical supervision of staff, the inspection and testing of equipment and submission of inspection schedules.
LOCATION: Vacancies exist mainly at Henlow. A small number of posts may also become available in S. Wales and Western and Northern England.
QUALIFICATIONS: A full five year apprenticeship or equivalent training. Experience in the development, manufacture, inspection, maintenance or testing of wireless or radar equipment. O.N.C. (Elect.) or City and Guilds Intermediate Certificate plus Radio II or an equivalent qualification. Applicants must be prepared to serve a tour or tours of 2 or 3 years' duration overseas.
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DUTIES: Assistance in the design and evaluation of radio communications, radio navigation and radar systems or assistance in the maintenance and modification of equipment in a Radio Telegraph Station.
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APPOINTMENTS will be unestablished but opportunities for permanent appointments are likely to arise.
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THE UNIVERSITY OF SOUTHAMPTON.

DEPARTMENT of Physics.
TEMPORARY Contract Assistant required to construct and test electronic equipment for satellite instrumentation. Candidates should have had experience with transistorised circuitry. Salary up to £900 per annum according to age and qualifications. Period of appointment two years. Applications in writing, giving details of age, education and experience and the names of two referees should be sent to the Secretary and Registrar, The University, Southampton, as soon as possible. [2661

JERSEY CIVIL SERVICE.

A VACANCY exists for a Technical Officer in the Harbours and Airport Committee's Telecommunications Department.
THE officer will be engaged on the installation and maintenance of Marine and Aeronautical Navigational Aids and Communications equipment.
QUALIFICATIONS: Ordinary National Certificate in Electrical Engineering, or the City and Guilds Intermediate Certificate in Telecommunications (old syllabus) plus Radio II, or Intermediate Certificate in Telecommunications (new syllabus) plus certificates in Mathematics B, Telecommunications Principles B and Radio and Line Transmission B, and at least five years' appropriate experience.
SALARY on scale £1,118-£1,270 per annum.
APPLICATION forms may be obtained from the Establishment Officer, States' Greffe, Jersey, C.I. Completed forms must be returned not later than 31st January, 1964. [2666

CHIEF broadcasting engineer.

GOVERNMENT of Uganda.
APPLICATIONS are invited from candidates, under 50, with Corporate Membership of either the I.E.E. or the Brit. I.R.E. plus extensive executive experience in a National Sound Broadcasting Organisation; familiar with M.F. and H.F. propagation and practical experience of high power transmitters and associated studio equipment.
DUTIES of the post will be to assume complete responsibility for all technical aspects and staff of the National Sound Broadcasting Service. Equipment includes 50 K.W. M.F. and 10 K.W./H.F. transmitters with associated mast radiators and vertical incidence aerial arrays, and modern transistorised studio equipment with semi-automatic continuity equipment.
The appointment will be for one to two tours at candidate's option with a salary in the range of £2,502-£2,664 plus a gratuity of 25%-45% of total emoluments. Free family passages. Free medical attention and furnished quarters provided at moderate rentals. Generous leave and education allowances. Apply to Director of Recruitment, Department of Technical Co-operation, Eland House, Stag Place, Victoria, S.W.1, quoting D26/RC 237/153/012. [2643

AN OVERSEAS CAREER WITH

INTERNATIONAL AERADIO, LIMITED.
TO meet the requirements of constant growth and expansion we invite applications from technicians and engineers for a overseas career in North West and East Africa, the Mediterranean area, the Caribbean, the Arabian Gulf and the Far East. If you have recently completed service in a trade such as Ground Wireless Fitter in the R.A.F. or Radio Electrical Artificer in the Royal Navy or have other experience in the maintenance of HP and VHF communications, RTT and navigational aids, we should be interested to hear from you. Successful candidates would normally spend six weeks at our Radio Training School, Southall, Middlesex, before proceeding overseas, but in some cases staff with suitable qualifications and experience may be offered immediate posting. Overseas staff receive a tax-free salary with married and child allowances if appropriate and accommodation, bachelor or married, is provided free; other benefits include generous U.K. leave and membership of an excellent pension and life assurance scheme.
WRITTEN applications, please, to Personnel Officer 40, Park St., W.1. [0084

IMPERIAL COLLEGE, London, S.W.7.

AUTOMATIC Control Group.
THIS Group is currently organising large-scale projects in connection with an advanced research programme involving automatic control, digital and analogue computers, and special purpose electronic equipment.
THERE are vacancies for technical and development staff at salaries ranging from £760 to £1,760 p.a., with superannuation benefits. Full details of experience and qualifications to Professor Westcott, Electrical Engineering Dept., by 21st January. [2634

PEGASUS COMPUTER MAINTENANCE

Digital computing facilities are provided by the Operational Research Department of BISRA for the benefit of other sections of BISRA and for member steel companies, in addition to the extensive use made of these facilities by the department itself in carrying out its own work.
Applications are invited for the post of Maintenance Engineer for the Pegasus computer installation at BISRA's Battersea Laboratories. Although the basic responsibility of the maintenance engineer is to maintain the computer in good working order, the opportunity does arise to design and construct additional electronic devices.
Suitable applicants will have had some experience in maintaining digital computers or similar electronic equipment and will possess a Higher National Certificate or a qualification of an equivalent standard. Training facilities in Pegasus computer maintenance will be provided, if necessary, for an otherwise suitably qualified engineer.
Applications, stating age, qualifications and experience should be sent to:—

BISRA

THE PERSONNEL OFFICER, BRITISH IRON & STEEL RESEARCH ASSOCIATION,
24, Buckingham Gate, London, S.W.1.

GOVERNMENT COMMUNICATIONS HEADQUARTERS
requires
RESEARCH AND DEVELOPMENT CRAFTSMEN

RADIO MECHANICS for the maintenance and installation of radio communication receivers and equipment.

TELEPRINTER MECHANICS for the maintenance of teleprinter and cypher machines and associated telegraph equipment.

COMPUTER MECHANICS for the maintenance of computer peripheral equipment including magnetic tape handlers, paper tape equipment and electric typewriters.

WIREMEN for prototype sub-assembly layout, wiring and testing of radio and computer type chassis.

BASIC PAY £11/12/- per week plus supplementary pay up to 87/- per week. Supplementary pay will be assessed at interview based on ability and the necessary basic qualifications.

Apply in writing to:
Recruitment Officer (RDC/3), G.C.H.Q. "A" Block, Oakley, Priors Road, Cheltenham, Glos.

G.E.C. COVENTRY

G.E.C. (Telecommunications) Ltd. are manufacturers of transmission systems in the VHF and micro-wave bands, and electronic and electro-mechanical telephone exchanges. We are going through a stage of considerable expansion and will be requiring the following staff from time to time over the next 12 months:—

TEST DEPARTMENT

For the junior vacancies we would like to see evidence of progress in ONC or in City and Guilds telecommunications subjects. Men who have been working on electronic or telecommunications equipment in the Services are particularly welcome. For the senior vacancies some years' experience on electronic or electro-mechanical equipment preferably combined with formal qualifications are desirable. Starting salaries are in the bracket £13/6/- to £18 a week.

CONTRACT ENGINEERS

Would be particularly attractive to men who have had wide experience of the installation and commissioning of complex telecommunications systems and who are now seeking more static employment. Starting salary not less than £1,000 a year.

INSTALLATION

Testers and installers for the installation and commissioning of transmission equipment both in the U.K. and overseas.

ELECTRONIC DESIGN ENGINEERS

Production of manufacturing drawings from laboratory schematic sketches. A formal qualification together with a mechanical as well as an electronic bent and draughting experience are required. Starting salaries are in the bracket £15-£17 a week.

Apply, with full details of age, education and experience to:—

THE STAFF OFFICER

THE GENERAL ELECTRIC CO., LTD.

Telephone Works, Copeswood, Coventry

ROYAL Naval Scientific Service.

GOVERNMENT Communications Headquarters, Cheltenham, Glos.
SCIENTIFIC Officers/Senior Scientific Officers. MATHEMATICIANS required for computer application and programming, and for combinatorial and statistical research. Physicists and electronic engineers for research, development and design work in telecommunications field involving use of latest equipments and modern techniques. Qualifications: 1st or 2nd class honours degree or equivalent in appropriate subject. Also for S.S.O. at least 3 years' post-graduate experience.
SALARY. S.O. £791-£1,309. S.S.O. (minimum age 26) £1,438-£1,772.
F.S.S.U. opportunities to compete for established posts.
EXPERIMENTAL Officers/Assistant Experimental Officers:
MATHEMATICIANS for computer programming. Qualifications: 2 G.C.E. "A" levels in science or maths. plus 3 "O" level subjects. If over 22, degree, Dip.Tech., or H.N.C.
SALARY: E.O. (minimum age 26) £1,164-£1,431. A.E.O. £490 (age 18)—£858—age 26 or over)—£1,053.
APPLY to S.S.P., Admiralty, Empress State Building, London, S.W.6. (5) [2641

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD.
FISHERIES Laboratory, Lowestoft.
ASSISTANT experimental officers/experimental officers (male) for work, both in the laboratory and at sea, on the design, construction, and maintenance of a wide range of electronic equipment for instrumentation in fisheries and scientific research. Qualifications: H.N.C. (or equivalent) preferred. (Minimum:—G.C.E. "A" level in Physics and another science.) Good electronics experience essential.
SALARY: A.E.O. £691 (at age 22)—£858 (26 or over)—£1,053); E.O. (minimum age 26) £1,164-£1,431. Opportunities for establishment. Application form from Director, Fisheries Laboratory, Pakefield Road, Lowestoft, Suffolk. Closing date January 13th, 1964. [2651

CADBURY BROTHERS, Ltd., have a vacancy for a senior control and systems engineer. ABLE to design and apply electrical, electronic and magnetic devices to food processing and handling plant. The position is progressive and offers interesting work to a man with a logical and ingenious approach to control problems. Candidates must be willing to work in co-operation with other staff members, technical and professional.
APPLICATIONS, stating age, qualifications, experience and salary required, should be addressed to E.M.A., Cadbury Brothers, Ltd., Bourneville, Birmingham. [2631

UNIVERSITY COLLEGE OF NORTH WALES, Bangor.
Applications are invited for the post of Senior Technician in the Department of Psychology. Experience in electronics essential. SALARY will be on a scale rising from £760 to £900 per annum.
TWO copies of the application giving details of age, qualifications and experience together with the names of two referees should be sent to the Registrar by January 15th, 1964. [2663

TELEVISION engineers are invited to gain 625 experience at our London branches, good wage, sales bonus, pension, etc.—Apply Robinson Rentals Ltd., Services Dept., 43-45 St. Peters St., Bedford. [2648

INSTITUTE OF NEUROLOGY AND NATIONAL HOSPITAL.
ELECTRONIC Engineers required (2 posts available) for development and maintenance of equipment used for Medical Research in the University Department of Clinical Neurology and the Department of Applied Electro-physiology. Appointment as Senior or Chief Physics Laboratory Technician (£815-£1,300 per annum) according to qualifications and experience. Applications to the Secretary, The National Hospital, Queen Square, London, W.C.1. [2650

INDUSTRIAL electronic control—specialist with experience in design of systems offered post in new company; prospects of directorship later.—Please reply, giving fullest details of experience, to Box 5274. [2653

TEST ENGINEERS

Expanding activities in a leading Company give rise to vacancies in Telecommunications embracing Units and Racks of equipment in the Telephone, VFT and Pulse fields.

IN LABORATORY

Collaboration with design engineers.
Preparation of Test information.
Consultation during testing.
Interpretation of Test results.

Experienced and qualified engineers will find the work interesting and varied.

IN FACTORY

Testing and inspection vacancies.
Fault location and clearance on all types of Electronic Telecommunication Equipment. Please write, stating age, qualifications and experience to: *Box Number* 5275, c/o "Wireless World."

Good prospects including Staff status for suitably qualified and experienced testers.

VACANCIES IN
THE COMPOSITE SIGNALS ORGANISATION
A number of vacancies, offering good career prospects, exist for:-
RADIO OPERATORS (MALE)
Write, giving details of Education, Qualifications and Experience to:-
Recruitment Officer (CSO/3), Government Communications Headquarters, 'A' Block, Priors Road, Cheltenham, Glos.

ELECTRONIC ENGINEERS

Men with O.N.C. or equivalent experience required for Test Room on a variety of instruments and equipment for H.M. Services. Suit radio technicians with experience on ground radio and radar equipment. Staff position. Salary in line with qualifications and experience. Holiday arrangements honoured. Superannuation scheme. Company station transport.

Apply in writing to Personnel Officer,
PETO SCOTT ELECTRICAL INSTRUMENTS LTD.
Weybridge

CANTERBURY EDUCATION AUTHORITY.
TECHNICAL COLLEGE.
APPLICATIONS are invited for appointment, from 1st January, 1964, or as soon after as possible, as Assistant Grade "B" for Radio and Television Servicing and Telecommunications to Final City and Guilds standard, and to assist with the development of courses in Industrial Electronics. Applicants for this post should have at least a City and Guilds Final Certificate in one or more of the subjects mentioned, together with a H.N.C. in Electrical Engineering (Light Current), and should also have had sound industrial experience. Teacher-training or teaching experience would be an added recommendation. Salary in accordance with the Technical Scale Grade "B," £830 to £1,450 with allowances, where appropriate, for degree and approved industrial experience.
FURTHER particulars and forms of application may be obtained from the Principal, Technical College, Longport, Canterbury. Completed forms should be returned as soon as possible.
N. POLMEAR, Chief Education Officer,
Education Office, 78, London Rd., Canterbury, Kent. [2635

ACTIVE partner/director considered by expanding London recording studio; min. capital £2,000.—Box 5277. [0141

TEST engineer required for electronic instruments; 40-hour week.—Levell Electronics, Ltd., Park Rd., High Barnet. Tel. Barnet 5028. [2668

BRADFORD INSTITUTE OF TECHNOLOGY
INSTRUMENTATION Research
A RESEARCH Assistant is required in the Department of Chemical Engineering to undertake research work on instrumentation and automatic control systems. He will be expected to undertake research work in one or more of the following fields:
MEASUREMENT of level and flow of powdered materials using electronic techniques.
MEASUREMENT of humidity.
SPEED of response to control systems.
APPLICATION of analogue and digital computers.
APPLICATIONS will be considered both from newly qualified graduates and from suitably qualified men or women with industrial or research experience.
THE post is superannuable and the starting salary will be dependent on experience and qualifications within the range £700-£1,500. For further particulars apply to the Registrar, Bradford Institute of Technology, Bradford, 7. [2659

WAR DEPARTMENT, 33, Central Workshop REME, Newark, Notts
TELECOMMUNICATIONS Mechanics for overhaul of wireless equipment, starting range of pay £11/11 to £12/13; progression beyond this according to service and qualification. Five-day 42 hours working week, opportunities for external training and promotion.—Apply to Officer Commanding, 33, Central Workshop REME, Lincoln Road, Newark, or local office the Ministry of Labour, quoting reference 33/CW/1. [0232

VACANCIES in the Diplomatic Wireless Service of the Foreign Office.
THE Diplomatic Wireless Service has vacancies at Hanslope Park, Wolverton, Bucks, and Boreham Wood, Herts, for test engineers.
FULL apprenticeship plus industrial experience in communications equipment is preferable but applicants engaged upon radio servicing will be considered.
SALARIES will be within the following scales according to age and qualifications:
£714 (age 25)—£947 per annum.
£886 (age 26)—£1,059 per annum.
POSSESSION of O.H.C., or equivalent, may warrant higher starting pay.
LOWER starting salaries apply to younger candidates.
APPOINTMENTS will be on a temporary basis in the first instance but there will be opportunities for suitably qualified candidates to compete for establishment at a later date.
CANDIDATES and both their parents must have been British subjects at all times since birth.
CANDIDATES must be prepared to undergo medical examination.
APPLICATIONS in writing, giving age, qualifications and experience, to the Personnel Officer, Diplomatic Wireless Service, Hanslope Park, Wolverton Bucks, quoting T.E.1. [2628

CLOSED CIRCUIT T.V. TESTERS

We invite applications from test engineers, preferably with previous industrial experience on television equipment. Interesting work on TV cameras, camera control units and a variety of monitors including transistor equipment.

Successful applicants will be offered positions on the Company's permanent staff. Salary in line with qualifications and experience. Holiday arrangements will be honoured. Superannuation scheme. Company station transport.

Apply in writing to Personnel Officer,
PETO SCOTT ELECTRICAL INSTRUMENTS LTD.
Weybridge

SOUTH OF SCOTLAND ELECTRICITY BOARD.
HUNTERSTON Nuclear Generating Station.
INSTRUMENT Mechanics are required at Hunterston Nuclear Generating Station, West Kilbride, Ayrshire, to service a wide range of physical, electro-mechanical and electronic instruments. These situations offer unrivalled opportunities for first class mechanics to widen their knowledge and gain experience on up-to-date, modern techniques. If you can service any two of the following and would like to live and work in pleasant surroundings on the Ayrshire coast, then we would like to hear from you:—
(1). Temperate, pressure and flow measuring instruments
(2). Precision mechanisms and printers.
(3). Automatic telephone exchanges.
(4) Closed circuit television and V.H.F. radio.
(5) D.C. and pulse amplifiers.
(6). Transistor amplifiers and controllers.
(7) Transistor digital and logic circuits.
THESE posts are permanent. 42-hour, 5-day week. Hourly rate 6/7½ plus productivity allowance of 4/6 per week. On completion of two years' service an additional 8/6 per week is paid. Sick pay and superannuation schemes. Housing will be available within reasonable distance of the Generating Station to suitable applicants.
APPLICATION forms are obtainable from the Station Superintendent, Hunterston Nuclear Generating Station, West Kilbride, Ayrshire, and should be returned within four weeks of the appearance of this advertisement. [2606

ELLIOTT

TECHNICAL ASSISTANT

required by the High Voltage Tube Division. The Division's products include electronic tubes and vacuum devices. Applicants should be experienced in high voltage and pulse techniques.

The preferred age for this position is between 30 and 45.

Ex-service personnel will be considered for this position.

Please apply in writing giving full details of qualifications and age to the:

Personnel Officer (Ref. P.0211)
ELLIOTT BROTHERS (LONDON) LIMITED
Elstree Way, Borehamwood, Herts

EA A Member of the Elliott-Automation Group

SMITHS RADIOMOBILE

Britain's Car Radio specialists

invite applications from

RADIO SERVICE ENGINEERS

These appointments are progressive and there are prospects of advancement for men with the right experience and ability. Please apply to:

The Personnel Manager, S. SMITH & SONS (RADIOMOBILE) LTD., Goodwood Works, North Circular Rd., LONDON, N.W.2.

(Near Staples Corner)

Or telephone for an appointment, GLAdstone 0171.

ELCONTROL LTD.

TECHNICAL,
TEST AND SERVICE ENGINEERS

Young men interested in working on industrial electronic controls and automation devices.

We have vacancies in Technical Department for experimental assistants and in test and service sections. Real enthusiasm with initiative and determination and genuine interest in transistor electronics more important than qualifications. We are interested in young men who have a real urge to invent and experiment but whose lack of these qualifications is perhaps hindering them in their present job. Radio and TV engineers would find work interesting and rewarding—Please send full details in chronological order with salary required to **Managing Director, Elcontrol Ltd., 42, Wilbury Way, Hitchin, Herts.** Age limits we would suggest are from 17—40 but exceptional applicants outside these limits would be considered.

MAIL order manager required.—Central London (Hi-Fi). State experience in confidence.—Box 5192. [0139

SKILLED personnel required for long term Government and commercial projects. Work in Audio, L.F. and instrumentation fields.
(a) ELECTRONIC Testers. Staff appointments £850-£900 p.a. plus overtime. Contributory pension scheme after qualifying period.
(b) ELECTRONIC Inspectors. Basic weekly rate £15-£16 plus overtime. May eventually be eligible for staff appointments.
(c) MECHANICAL Inspectors. Basic weekly rate of £14-£15 plus overtime. May eventually be eligible for staff appointments.
IN selected cases assistance may be given with housing.
APPLY in writing to Mr. R. Evans, Hartley Electromotives Ltd., Octopus Works, Monkmoor Rd., Shrewsbury, Salop.
STATE age, experience and qualifications.
TRAVEL expenses will be paid for candidates selected for interview. [2660

TECHNICAL sales correspondent required immediately to assist sales manager; experience in aircraft, radio/radar systems essential.
WRITE full details of experience to: Sales Manager, Radio/Radar, FieldTech, Ltd., London Airport. Tel. Skyport 2141. [2625

VACANCIES for electronic mechanic grade I exist at the School of Electronic Engineering, REME, Hazebrouck Barracks, Arborfield, Nr. Reading.
QUALIFICATION for appointment:—
THE work includes fault finding in complex electronic circuits, the repair, maintenance and modification of electrical, electronic and light mechanical assemblies.
RATE of pay:—282/- to 307/-.
FULL particulars may be obtained from the Commandant of the above School or C.E.P.O., C.A.D. Bramley, Nr. Basingstoke, Hants. [2640

ELECTRONIC engineer, specialising in flash, tape recorder and sound unit repairs, required for senior position in Dixons Service Division; pay and conditions are acknowledged the finest in the trade.
PLEASE write: Dixons Photographic, Ltd., 494/496, Honeypot Lane, Stanmore, Middlesex. [2630

TELEVISION field engineer wanted, clean driving licence, must be conversant with all makes and be able to work on own initiative, salary according to experience.—Hammants, 26-28 Bell St., Henley on Thames. [2644

RADIO engineers, senior and junior electronics engineers required by internationally known organization; candidates must be single, medically fit, prepared to spend periods of up to two years abroad, and be able to accept responsility for the success of projects.
QUALIFICATIONS: Senior posts—B.Sc., H.N.C. or equivalent plus industrial experience. Junior posts—O.N.C. or experience as a first-class skilled radio mechanic.
A knowledge of modern survey techniques is an advantage.
BOX 5268. [2624

TELEVISION aerial designer with knowledge of engineering and production required by well known TV rental company for work on 1964 programmes; candidate should be well experienced, between 30 and 40 years, and should supply full details to Box 5050, c/o Kingscott Advtg., 18-20, St. Andrew St., London, E.C.4. [2627

B.P. requires an engineer qualified to H.N.C. standard to operate and maintain a new telecommunications/telemetry network in the Arabian Gulf. Applicants, aged 24-30, should have experience with modern medium power MF, HF and VHF single and multi-channel radio, radar, small auto telephone exchanges and must have experience of digital data telemetry and control systems using transistors and other solid state devices. The position is "single status" with home leave every 4 months, and is for an initial contract of 2 years. Conditions of service are excellent.—Please send full details of qualifications and experience quoting ref. F.631, to Box 3530, c/o Hanway House, Clark's Place, E.C.2. [2669

WAR DEPARTMENT

Royal Armament Research and Development Establishment, Potton Island

require

Skilled FITTERS/TURNERS
ELECTRONIC/MECHANICS
Semi-Skilled EXPERIMENTAL WORKERS
(In electronic labs. and magazines)
RANGE WORKERS

Good conditions of service. Paid annual leave in addition to paid Public Holidays.
Paid sick leave scheme.
Prospects of pensionable employment after a qualifying period.

For further particulars apply to:—

The Administrative Officer (W.W.),
R.A.R.D.E.,
Potton Island, Great Wakering,
Southend-on-Sea, Essex.
Telephone: Great Wakering 491

A W R E

ALDERMASTON

Vacancies for ELECTRONICS ENGINEERS

Information on —

Rates of pay ** Housing ** Lodging Allowance ** Sick pay ** Superannuation can be obtained on application by postcard, quoting ref. PA/923/45, to

The Industrial Recruitment Officer,
Building F.6.1,
A.W.R.E. Aldermaston,
Berks.

TESTERS

required for interesting work on L.F. and H.F. Transmitters. Previous fault-finding experience essential.

The positions available would be of special interest to persons employed in the fault-finding and repair of television who are keen to establish themselves in a position that offers:

- ★ Satisfactory employment
- ★ Five-day week
- ★ Good prospects of advancement
- ★ Staff status
- ★ Sick pay
- ★ Generous salary

Apply: Personnel Manager

Multitone Electric Co. Ltd.

12-20 Underwood St., London, N.1

AIR MINISTRY have vacancies for civilian radio technicians at R.A.F. Sealand, Cheshire, for the servicing, repair, modification and testing of air and ground radio and radar equipment; commencing salary according to age is £701 to £902 p.a., max. salary £1,036 p.a.; houses may be available for renting at West Kirby some 15 miles from Sealand.—Apply to Air Ministry C.E.3h, Sentinel House, Southampton Row, W.C.1, or to any Employment Exchange. [2629

TEST engineers.—Applications are invited from test engineers with previous industrial experience of testing radio communications, receivers and transmitters; successful applicants will be offered positions on the company's permanent staff; starting salaries commensurate with qualifications and experience.—Apply in writing, giving full details to Personnel Officer, Redifon, Ltd., Broomhill Rd., S.W.18. [0252

THE London Hospital, Whitechapel, E.1, has a vacancy for a Senior Electronics Technician for both routine and development work in its Physics Department; preference will be given to candidates with H.N.C. or better qualifications in electronics, but they should certainly have had experience in the maintenance and construction of electronic equipment; salary according to experience.—Applications to the House Governor. [2654

COI.—The Central Office of Information requires a qualified and experienced telecommunications officer (unestablished) to oversee the world-wide network of communications used by the C.O.I. for the purpose of supply press material to the Information Officers of H.M. Embassies and High Commissions, and to be responsible for planning future developments. The successful applicant must be familiar with the latest technical developments; experience in running a communications system overseas and in dealing with Government departments will be an advantage. Salary £1,705 to £1,875 p.a.
WRITE, giving age, full details of experience and qualifications, by 13th January, 1964, to Manager (PE.5032/EW), Ministry of Labour, Professional & Executive Register, Atlantic House, Farringdon St., London, E.C.4. [2626

FIELDEN ELECTRONICS LTD.

Paston Road, Wythenshawe, Manchester, 22

wish to appoint a Chief of Test and Inspection to be responsible for all aspects of Quality Control from Goods Inward to Final Test and Calibrations of Industrial Electronic Equipment.

An attractive salary will reflect the importance of this position.

Please reply in detail to the Chief Engineer.

ICT

An opportunity to work on I·C·T computers in the 1100, 1300, 1500, Atlas, Orion, Sirius, Mercury and Pegasus ranges

There are a number of attractive vacancies in our Field Engineering Division for Electronics Engineers aged 23 to 35 to maintain, after training, this range of I·C·T computers.

Applications are invited from suitably qualified engineers interested in working in this important and expanding field of Electronic Computing.

Successful applicants will receive full training in computer techniques. Consideration will be given to candidates possessing either:

1. H.N.C. (Electrical) or H.N.C. (Electronics) or similar qualifications and industrial electronic experience

or 2. Extensive practical industrial experience in pulse techniques (men with radar maintenance experience in H.M. Forces are especially welcome).

These are permanent, salaried positions which offer real scope for advancement. Holiday, Sick Pay and Retirement Schemes are excellent.

If you are interested in a career with I·C·T as a Field Engineer write (quoting reference FerrDiv) to:—

Personnel Section,
Field Engineering Division,
International Computers and Tabulators Limited,
85-91 Upper Richmond Road,
London, SW15

VACANCIES exist in our Malvern office for Technical Personnel with Electronic Engineering knowledge for preparation of Technical Documentation for Services Equipment. Ability to read drawings with facility essential. Educational level should be O.N.C. or equivalent experience. 5-day week and good salary. If you feel you have the necessary qualifications and are interested, write or telephone Architype Services, Ltd., 12, Worcester Road, Malvern. Te. 61551/2 [2607

OIL exploration.—Holders of H.N.C. with Electronics, or higher qualifications, are offered a permanent career in Geophysics; from headquarters in the U.K. we operate at home and on the continent, but more frequently in remote areas; actively developing methods, mainly electronic, in which your initiative may play its part, add technical zest to a life that can be adventurous; ability to get along with men of other nationalities is of prime importance.—Please write to Box 5218. [0332

VACANCIES EXIST IN U.S.A. and CANADA

for

Qualified and Experienced Electronic Engineers. Excellent Salaries and Opportunities. We have also Vacancies in the London and Home Counties area. Please Write or Phone in the Strictest Confidence. Our Services are Offered Completely Free of Charge to the Employee.

ELECTRONICS APPOINTMENTS BUREAU

Gloucester Mansions, Cambridge Circus, London, W.C.2.

Quote Ref. EA/2. COVent Garden 0280

SITUATIONS WANTED

EX-GOVT. retired unlicensed W/T operator and technician with a wide experience in radio-communications, maintenance and repair, seeks employment anywhere, multi-linguist but not British born.—Box 5272. [2639

BOOKS, INSTRUCTIONS, ETC.

A QUANTITY of Wireless Worlds dating from 1956-60.—Box 5269. [2633

NEWNES RADIO AND TELEVISION SERVICING, 1956-1963, hardly used, £10.—31, Newport Crescent, Mansfield, Notts. [2662

FOR sale, back numbers Wireless World, Jan. 1950 to mid-1963.—13, College Rd., Wembley, Middx. [2636

WEBB'S log book for recording signals heard and worked, 112 pages, 9¾×8in, approved format, semi-stiff covers, excellent value, 6/- post free, or callers 5/4.—Webb's Radio, 14, Soho St., London, W.1. [0021

RECEIVERS AND AMPLIFIERS—SURPLUS AND SECONDHAND

HRO Rx's, etc., AR88, CR100, BRT400 G209, S640 etc., etc., in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd. London, E.11. Ley. 4986. [0053

TRANSMITTING EQUIPMENT—SURPLUS AND SECONDHAND

WANTED, four transmitters type T-1154 and three dynamotors, 24 volts.—Phone Roy 1761. [2667

NEW TEST EQUIPMENT

HEATHKITS can now be seen in London and purchased on easy terms; free brochure.—Direct TV Replacements, Ltd., Dept. W.W. 27/1, 126, Hamilton Rd., London, S.E.27. Gip. 6166. [2307

TEST EQUIPMENT—SURPLUS AND SECONDHAND

SIGNAL generators for sale, TF 144 F £25; TF 144 G £30; Audio No. 5 £25; all plus carriage.
RADIOVOX Ltd., 5, Oxford Place, Leeds, 1. [2657

TWO A.F.M 2, Avo signal generators 450 Kc/s -225Mc/s, AM/FM mains operated; £30 each.—James, 159, Whittucks Road, Hanham, Bristol. [2664

TELEQUIPMENT TV pattern generator WG44 mint, cost £62, £30 o.n.o.; Avo, C. R. bridge, £5; Marconi Sig. gen. 390G, as new, £15.—Craig, 8, Elm Rd., Cleethorpes, Lincs. [2665

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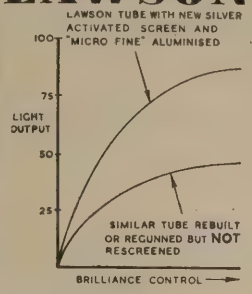

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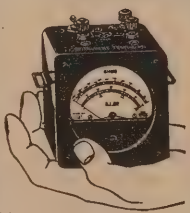

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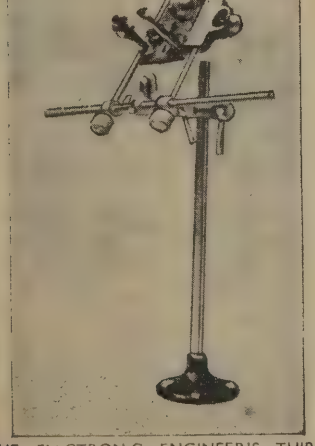

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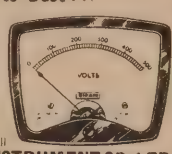

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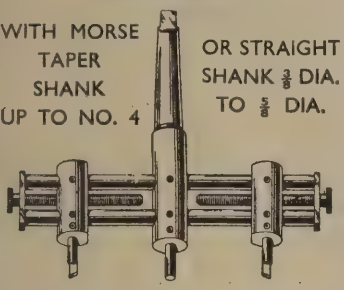

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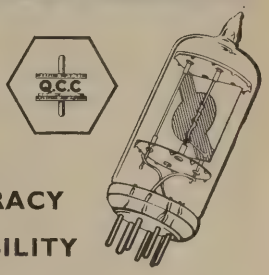

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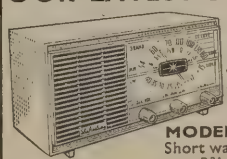

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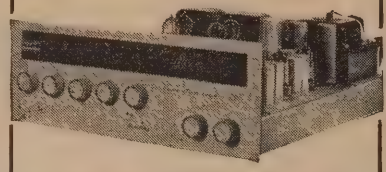

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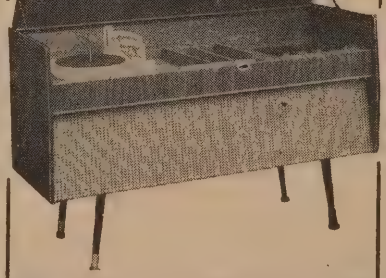

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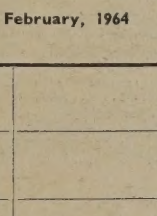

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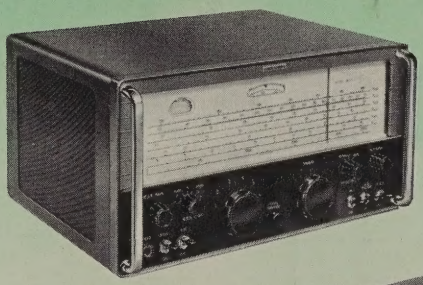

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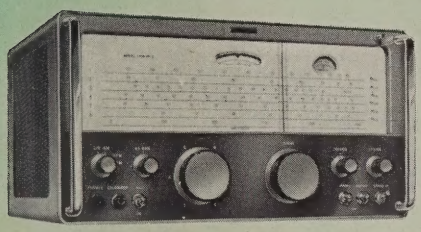

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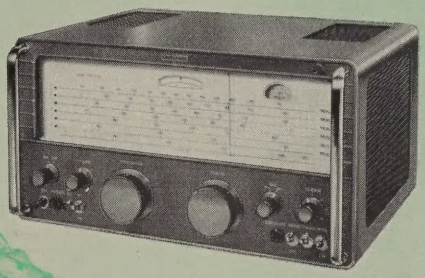

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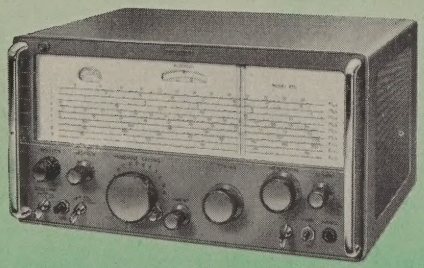

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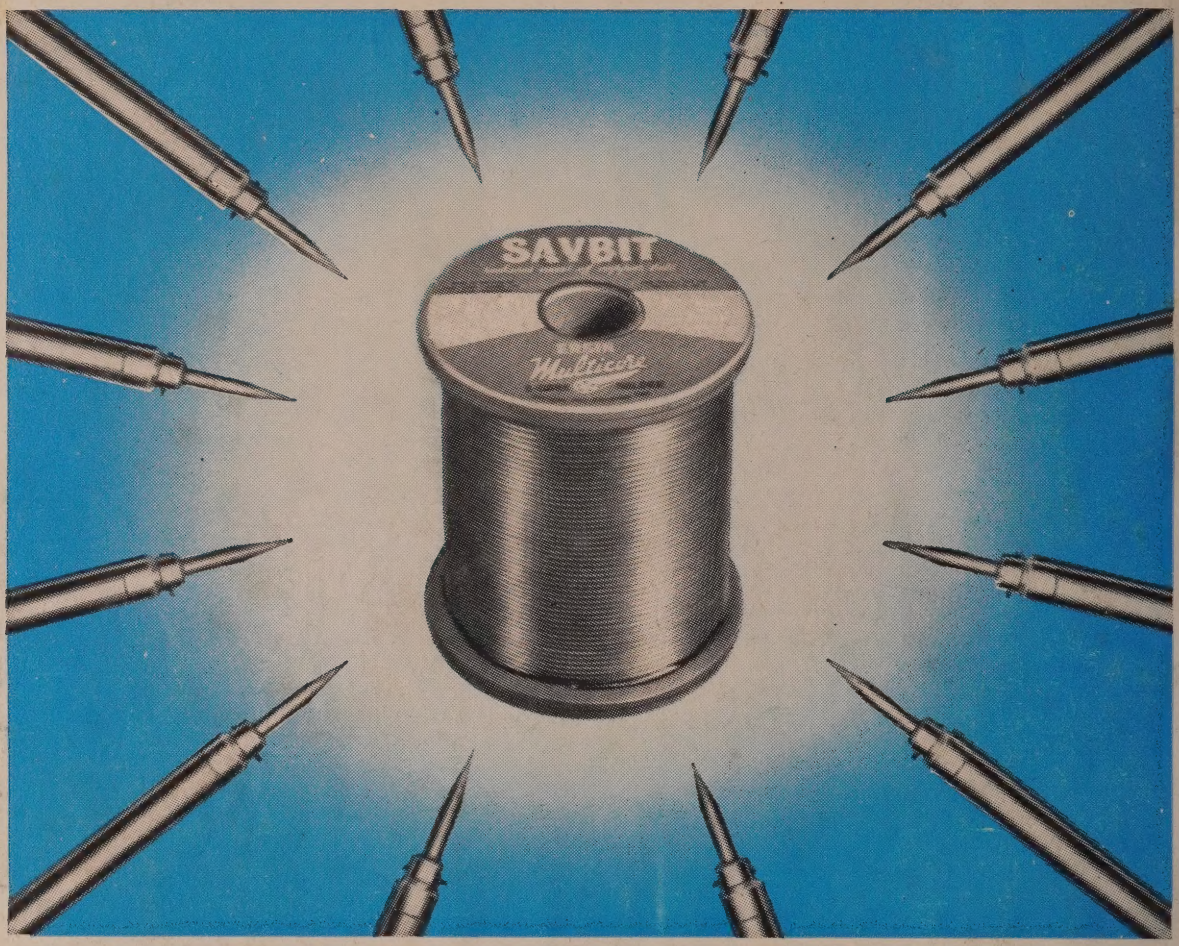

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